THE

AMERICAN NATURALIST,

AN ILLUSTRATED MAGAZINE

OF

NATURAL HISTORY.

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VOLUME XVII.

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PART SECOND.

PHILADELPHIA:
PRESS OF McCALLA & STAVELY,
Nos. 237 and 239 Dock Street.
1883.

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THE

AMERICAN NATURALIST.

VOL. XVII.—*JULY*, 1883.—NO. 7.

THE NATURALIST BRAZILIAN EXPEDITION.

BY HERBERT H. SMITH.

SECOND PAPER.—THE LOWER JACUHY AND SÃO JERONYMO.

A FEW days after our arrival at Porto Alegre we were invited by Mr. B., a German merchant, to visit his coal mine at Sao Jeronymo, fifty miles from the city; berths were given us on a small steamer which our friend was about to despatch to the mine, and he himself finally consented to accompany us.

Our course lay up the river Guahyba, which, above the city, is much widened, the channel being divided by several islands; here it receives several branches, spreading out in different directions like the fingers of a hand, whence the local name of Viamao, or handway, sometimes applied to this section. The upper continuation of the Guahyba is properly the Jacuhy, which enters the Viamao from the west. This is the largest and much the most important river of the province. It rises on the southern flank of the Serra Geral and takes a general southerly course as far as Cachoeira, where the rapids end; from thence it flows eastward, with few curves, to the Viamao. The whole length, including the Guahyba, is not far from 400 miles, and it is navigable for small steamers, except during droughts, as far as Cachoeira, 175 miles from the Lagoa dos Patos; large lake steamers sometimes run up to São Jeronymo, fifty miles from Porto Alegre.

For some time after we entered the Jacuhy we saw only low, steeply-cut banks, lined in most places with forests of no great height; willows and leguminous trees were abundant, but palms and woody climbers were almost wanting, so that the woods

reminded us strongly of home. This forest belt is a mere screen, hiding flat, open meadow, or mimosa thickets, behind. Thickets and forest belong to the alluvial land of the river; in dry weather they are well above the water, but after heavy rains they are often covered to a considerable depth, the Jacuhy sometimes rising nearly forty feet. As on other rivers which are subject to heavy floods the alluvial lands are highest along the banks, where the silt and mud brought down by the water are first deposited. These high banks being more favorable to the growth of trees, are well wooded; the lower lands behind are often swampy, and they support only bushes and grass.[1]

The flood-plain of the Jacuhy is of small extent, generally little more than a mile broad; it is composed almost entirely of clays, though islands and banks in the channel are often sandy. The river itself, in its lower courses, varies in width from a quarter to half a mile, and it is generally deep all the way across; the current is rather rapid; water clay-stained but not muddy. As we advanced we could see low, rounded hills behind the forest on each side, and eight or ten miles below São Jeronymo the main land appeared at the river's edge on the southern side; beyond this it was continued, with little interruption, to the village. These banks are never very high, and they show only occasional ledges of soft, clay-like rock, with a pebbly beach below; they comprehend the space between the mouths of two small tributaries, called Arroio dos Ratos and Arroio da Porteirinha.

The first large tributary above the Viamão is the Rio Taquary, which enters from the north; it rises in the Serra Geral, and is important for the German colonies near its banks. At its mouth, on the northern side, is the village of Triumpho, and opposite it, on the south bank of the Jacuhy, the village of São Jeronymo. Triumpho is conspicuous for its handsome church; beyond this there is little to distinguish the two places. They are picturesque enough, the whitewashed and red-tiled houses backed by hedges and orange groves, or bright, prairie covered hillsides. Up the river there are wooded islands, and a rounded granitic rock appears above the water's edge directly in front of Triumpho.

We landed just above São Jeronymo, where there is a railroad running to the coal mine, about seven miles. Steam traction has

[1] Something similar is seen on the Lower Amazons, where I have noted it.

not yet been introduced, but Mr. B. ordered out a queer little box-like trolly, with a bony nag for locomotive; we seated ourselves in the box, six of us in all; B. touched the nag with his whip and the beast laid back his ears and started off in fine style. The day was a perfect one; the heat tempered by a cool south-west wind which here blows during a good part of the year. As soon as we had passed the village hedges we emerged into open prairie, beautiful rolling lands stretching back to higher hills on the south and west. The prairie was quite smooth and clean, the grass mingled only with low herbs or dwarf bushes; flowers were abundant, and among them we recognized such old friends as the scarlet and purple verbenas. Low tracts between the ridges were covered with a ranker growth; some portions were flooded, and here great flocks of water-birds had gathered, snowy white herons with an occasional black-winged stork or roseate spoonbill. A kind of rail, called here *Caracare*, was very common, often standing in pairs by the roadside and flying off with harsh cries when we came up; this species is generally seen on dry ground, though structurally it is a wader; an allied form (*Parra*) has immensely elongated toes to enable it to walk over the floating leaves of water plants.

A dozen thatched huts are scattered about the mine, which is marked only by the shaft-tower and engine-house. Here we were fortified with a preliminary lunch, and duly rigged in the very ill-fitting costumes which are usual on such occasions. My wife, with a miner's hood over her head, looked much like a very dirty friar; our tame marmoset monkey, Billy, sat on her shoulder, but crawled under the hood and clung to her hair in dismay as we dived into the blackness. The shaft is a perpendicular one, fifty-seven meters deep; the coal-bed varying in thickness from one and a half to two meters, dips very slightly to the north-north-west. The coal resembles Cardiff coal in appearance, but is more shaly, and contains a good deal of pyrites. Of its quality I shall speak farther on.

Most of the miners employed here are English or Irish, but there are a few Germans and Brazilians. They are paid one *milreis* (about forty-four cents) per carload for the coal, three loads being equivalent to a ton. At this rate a good miner will earn about 100 milreis, or $44 per month. Including the engineer, firemen, carpenter, blacksmith, &c., about forty men are

employed here. The passages are already extensive, but only one shaft has been sunk, the scale on which the mine is worked at present not warranting further expense. One engine of forty horse-power is used for the shaft, a smaller one being employed for pumping; the latter is required only once or twice a week, the mine being unusually dry.

After remaining several hours at the mine we returned to São Jeronymo, where we made our headquarters for several weeks. The place, which contains perhaps 800 inhabitants, is a very good example of the better class of villages in this part of the province. The streets are regular but unpaved except by the native pebbles; as usual there is a grass-grown, shadeless square, certainly far from ornamental, and having no particular use unless it be to pasture the village horses. The houses are generally well built of *adobe* or brick, white-washed and covered with tiles; there is a curious little chapel, but no church. The place contains several good-sized stores with general stocks, two hotels, an apothecary, blacksmith, saddler, carpenter, &c. A steam saw-mill has been erected, and there is an important establishment for the preparation of *matte*, or Paraguay tea, which is brought from the Serra do Herval, forty miles distant. We engaged two little dark rooms in the principal hotel, where the landlord took much pains to make us comfortable. Our dining-room and sitting-room also contained the billiard-table, which is inevitable in a Brazilian country hotel; luckily it was not much used except of a Sunday. We found, however, that the house was frequented by a party of rather noisy card-players, whose conviviality often robbed us of sleep. Now and then, too, a drinking bout would take place, and it was necessary to keep our doors well locked to bar out the revelers. For the rest the house was quiet enough, and we greatly enjoyed our stay here.

Our pursuits were a standing wonder to the village people, who frequently came to visit us; the boys especially would spend hours in gazing at us through the open window. Billy, the marmoset, came in for a share of admiration; the genus is unknown here, and there was much discussion as to whether the animal was really a monkey or something else. As Billy often accompanied us in our walks, perched on my wife's shoulder, she soon became known in the vicinity as *a senhora d'aquelle bichinhó*—the lady of that little beast.

Nearly all the country around Sao Jeronymo is open *campo*, or prairie, very similar to the pampas of Uraguay, with which it is continuous; it is varied only with strips of forest along the streams, and with occasional groves, or *capoes*, on damp hillsides. The landscape is beautifully fresh and park-like; the heat is seldom oppressive, even in the height of summer, and our long horseback explorations were a continual pleasure.

From one of the higher elevations, five or six miles south-east of Sao Jeronymo, an excellent idea may be obtained of the topography of this region. The country is seen to be occupied by many irregular ridges, which commonly trend east and west, but are much broken and excavated; their tops are generally rounded, and rocky ledges are not often seen. Between the ridges are branching valleys, and among and on the hills there are innumerable hollows, many of which have no visible outlet. These valleys and hollows are always more or less swampy, and the plants which grow in them are different from those of the main prairie; the grass is high and rank, mingled often with thorny bushes and thick-leaved aquatic plants. In journeying over the prairies one may pass thirty or forty of these *banhados* in the course of a day. The small ones are insignificant, but the larger are dreaded by the herdsmen, for in rainy weather they may be almost impassable; at any time the unwary traveler runs the risk of seeing his horse sink to the saddle girths—no pleasant predicament when one must dismount in the mud and rescue his steed as best he may. The banhados, in their general features, reminded me of the flooded meadows of the Lower Amazons during the subsidence of the river; some of the wading birds are, in fact, of the same species as those seen there.

The hills themselves are dry but fresh, with many clear streams of cold water. The ground is covered with short grass, mingled with innumerable flowering herbs; generally there are no bushes or trees, but in some places a kind of palm called the *potiá* is abundant. This palm grows to a height of thirty or forty feet, and has a thick rounded head of brushy pinnate leaves; it is never seen in clumps, but grows singly, scattered over the hillsides; seen from a distance it gives the landscape a curious dotted appearance. The fruit of the potiá has a yellow, acid pulp, which is eaten, and after a hot day's ride over the campos it is very refreshing. Many birds and mammals are fond of this fruit, and

it is probable that its edibility serves a useful purpose in propagating the species; the seeds being heavy would be disseminated very slowly by ordinary means; but as it is they are often swallowed whole by birds and passed unchanged through the intestinal canal, to be dropped, perhaps, at some distant point.

Wild Mammalia are not common here, and the species are few. One or two kinds of deer are sometimes seen, differing from the forest species in having branched horns; the country people speak of several species of foxes, but it is probable that these are merely varieties. Armadillos of three kinds are more abundant, and their burrows, hidden in the grass, make galloping over the campos a somewhat dangerous amusement. The smaller species devour termites, and one frequently sees the mines which the armadillos have made in the high conical nests of the insect. These nests are almost as hard as brick; the bones and muscles of the forefeet in the armadillos are specially modified so as to secure great strength for digging, and the large claws are used like miniature picks in boring the tough clay. The only rodent which I have observed is the *priá*, a small thickset species like a miniature capivara; it burrows in the ground and eats the seeds of campo plants. A small skunk is occasionally seen; it is very different from the North American species, and though it possesses the terrible weapon of its family, this is so seldom used that hunters do not hesitate to capture the animal with their hands.[1]

Nearly all the birds appear to be distinct from the forest species; hawks are particularly abundant, and of many species. Troops of ostriches (*Rhea americana*) are occasionally seen, but in this district they are very wary. When riding over the hills we sometimes gave chase to them, but one might as well attempt to catch a locomotive; the birds have a very awkward gait, but they cover the ground amazingly. Though so fearful of man they are not at all afraid of cattle, or of unmounted horses; frequently they are seen feeding among the herds. Their food consists of seeds, grass, insects and so on; the herdsmen say that they also eat snakes, and for this reason their flesh is hardly ever eaten, though it is said to be very good.

The nest is a mere shallow hole scratched in the ground;

[1] A rabbit and a small rat are also said to inhabit the campo, but I have never met with them.

twenty, thirty or more eggs are found together, but it appears that these are not all laid by one bird ; several females lay their eggs together and take turns in sitting on them.[1] The nest may be left uncovered during the heat of the day, but in this region, I believe, it is never entirely deserted.

The capões, or patches of forest, of which I have spoken, are quite different in their character from the main forest farther north ; many of the trees are of distinct species ; there are few vines or bushes, and one can ride freely beneath the branches. The tree trunks and boughs stream with long pendant lichens or "Spanish moss ;" there are many epiphytes, but orchids are not common, and I noticed only two species. The soil of these capoes is good, and they are the only lands used for plantations, the prairies being considered unfit for agriculture. I believe, however, that the banhados, if drained, would be excellent ; their soil, a rich black loam, could hardly fail to give abundant returns.

The campo lands are excellent for pasturage, and many thousand head of cattle are kept on them ; these are rather small but hardy, and well suited to the half-wild life which they lead. Horses are raised only in limited numbers, as the herdsmen require them ; like the cattle they are small, and may be considered as a degraded race. The best of them are excellent riding beasts for short journeys, but they are deficient in endurance. I believe that better breeds, both of horses and cattle, might be introduced here with great advantage. Sheep, which are occasionally seen, might do well, but the climate is probably too warm for successful wool-raising.

The German element is but slightly represented near São Jeronymo. The people are generally of Portuguese descent, the poorer classes with more or less intermixture of Indian or African blood ; there are few slaves, and not many free negroes. The status of the population is much like that of similar districts throughout Brazil ; there are a few educated and intelligent families, but the mass of the people are very ignorant, though not wanting in natural intelligence. All the men are, of course, excellent horsemen. Costumes vary with the class. The better families keep much the European style, the men only assuming

[1] This habit is recorded of the African ostrich, and I believe that it is common to a number of South American birds.

the *tamancos*, or wooden-soled shoes, about their houses, and the long boots and spurs, slouch felt hat and woolen *poncho*, or shawl, when riding. The poncho varies with the season; for cold or rainy weather it is a great circular cloak, generally of some dark cloth lined with bright red; the head is passed through a hole in the middle and the cloak falls around the body. When riding this covers the haunches of the horse, and the heat of the animal's body serves to keep the rider warm. Cloaks of similar form but of thin black cloth embroidered over the shoulders, are often seen in mild weather; the ordinary poncho, however, is a brown striped shawl, of woolen or cotton, according to the wealth of the owner; like the others it has a hole for the head. This form is used during the summer, and it frequently takes the place of a coat.

The true herdman's costume consists of a high-collared calico shirt, very wide, baggy calico trousers, or rather drawers, often of some bright color, and a wide sash at the waist; to these are generally added an old slouch hat and a pair of wooden-soled slippers which, when riding, may be carried in the hand. These men carry long sword-knives, and often a large, old-fashioned, double-barreled pistol, giving them a sufficiently warlike appearance. Rarely the *cherepá*, a cloth tied around the waist, is used in lieu of trousers. The saddle, at first sight, seems very clumsy, two great pieces of leather and a woolen cloth being generally carried under the saddle proper, which is only slightly curved; another cloth, or the skin of some animal, is fastened over the whole, so that the affair weighs two or three times as much as an ordinary English saddle. But the Rio Grande saddle, besides being a seat during the day, serves as a bed at night; the two pieces of leather are then spread on the ground with the cloth over them, and the herdsman, wrapped in his woolen poncho, sleeps at his ease.

The poorer class of houses are coarsely built of clay supported in a framework of poles and thatched with rushes. The standard articles of food are jerked beef and beans, but *matte*, or Paraguay tea, is found in every house. This beverage is extensively used throughout the southern part of South America, and it is so important that I will describe its preparation somewhat at length.

The matte plant[1] (*Ilex paraguaiensis*) grows in the high forest

[1] Called *herva congonha*, or simply *herva* in Brazil, and *yerba* in the Spanish republics.

of the region between the Paraná and the Atlantic, and perhaps also in the Matto Grosso. It is a shrub or bushy tree from ten to twenty feet high, and thickly covered with oblong-lanceolate leaves, which are furnished beneath with peculiar aromatic glands. The *hervaes* are commonly in mountainous districts, far from settled places, and the peasants make long journeys to gather the leaves. Having chosen a locality, they go over it in detail, hacking off all the smaller boughs, and leaving only the stems and lower parts of the main branches. Soon after gathering, the boughs are passed, one by one, through the flame of a long fire bed with certain aromatic woods; this operation lasts only half a minute for each branch, but it requires a peculiar dexterity not easily acquired; an unpracticed hand will burn the leaves or dry them unevenly. After this preliminary scorching the branches are cut into smaller portions, which are gathered into faggots and hung close together under a low shed; there a fire is maintained under them for twenty hours or more. To secure good matte this fire should also be fed with aromatic woods, which give a bright flame without smoke; the workmen, however, frequently use the first wood which comes to hand, such as the *araucaria*, or Brazilian pine, which imparts a disagreeable odor to the leaves. Being thus thoroughly dried the faggots are allowed to remain under the shed until the time arrives for sending them to the factory; they are then untied, and the twigs are strewn over a clear space of hard ground, which has been previously prepared; here they are thrashed with long poles until the leaves and twigs are reduced to small fragments. The mass is then gathered up and packed in baskets for transportation. Commonly the gathering is repeated at intervals of five or six years in each *herval*, and the product of a tree is said to be better after it has been despoiled several times. The first cutting may take place when the tree is fifteen years old. Sometimes the leaves of other species of Ilex are mixed with the true matte, to its great detriment. Attempts have been made to cultivate the tree, but without success; the seeds grow naturally only at intervals of several years, and under peculiarly favorable circumstances. It is said that germination takes place only in those seeds which have passed through the intestines of birds.[1] If this be true the fact will be an important

[1] Couty: Le Maté et les Conserves de viande, p. 17. In this work a very complete account is given of the preparation of matte.

addition to the large mass of evidence which tends to show that plants are intimately dependent on animals for their propagation. At all events it is certain that the Jesuits of Paraguay formerly utilized the bodies of their Indian servants to induce germination of Ilex seeds for their plantations.

Arrived at the factory, the leaves, if damp, are again dried by exposing them for several hours to gentle heat in a furnace or oven. The woody portions are then picked or sifted out, and the leaves are reduced to finer fragments in mortars. The commercial quality of the matte depends mainly on the thoroughness of the last two operations, but somewhat, also, on the region from which the leaves are gathered, nearness to or remoteness from the sea, and the skill and care shown in the drying operations. Paraguay *yerba* is perhaps the best, but that country furnishes only one-fifth of the matte which is consumed in South America; at least three-fifths is produced by the Brazilian province of Paraná, the remainder coming from Santa Catharina and Rio Grande do Sul.[1]

No South American thinks of drinking matte from a cup; it is taken from small globular or oval gourds, which are often prettily painted or carved, and sometimes elaborately ornamented with silver. The gourds are half filled with the leaves, sugar being sometimes added; boiling water is then poured in, and the infusion is sucked through a tin or silver tube, the end of which is furnished with a perforated bulb. The same leaves serve for several infusions. Among the Rio Grande peasants the *cuia* and *bombilha* handed to a traveler is the first mark of hospitality; when he has sucked the liquor out, the gourd is filled with water again, and passed to the next guest, or, in his absence, to a member of the family. Commonly the same gourd and bombilha complete the circle two or three times before they are finally laid aside.

(To be continued.)

[1] I have described the preparation as it takes place in Rio Grande; it differs somewhat in the other provinces and in Paraguay.

GROWTH AND DEVELOPMENT.

BY CHARLES MORRIS.

THE writer has endeavored to show, in a preceding paper,[1] that all the activities of animal life are largely, if not entirely, dependent upon the action of external influences. A fuller consideration of this subject seems desirable. There is no question but that the voluntary motions are instigated in the lowest animals directly by external stimulation. In the higher animals this instigation is partly direct and partly indirect, being largely that of mental influences, which arise from preceding individual or ante-natal impressions. Probably the involuntary motions have the same origin. We know that the digestive activities are set in motion by food pressure, and that the action of the kidney ducts is instigated by pressure, while it is not improbable that the actions of the heart and arteries result from a like influence.

If this rule be as general as it seems, then the animal body has no innate power of motion. All its activity is accompanied and rendered possible by oxidation, which furnishes its force. If oxidation never takes place except through nerve stimulation, as there is reason to believe, and if all nerve stimulation arises primarily or secondarily through the influence of external force contact, then the animal body is simply a mechanism adapted to respond to the touch of outer force, and possessed of no inherent powers of activity. However sensitive it may become through nutrition, yet if utterly removed from external influence it must remain quiescent, since oxidation of its protoplasm could not take place.

The organization of the body of the higher animals is in close accordance with this idea. Every portion of it is brought under the influence of external force. There has been evolved a highly complex nervous system, with sensitive extremities on every portion of the surface tissue, and on all the active internal membranes, while motor fibers penetrate every region of the internal body. Thus almost every cell is connected with the surface by force-conveying fibers. And the surface extremities of the sensory nerves are adapted to receive motor influences of almost every kind that exists in the external world. The skin is sensitive to the direct contact of moving matter and the vibratory con-

[1] AMERICAN NATURALIST, February and March, 1883.

tact of heat. The tongue receives the finer contacts of liquid, and the nasal nerves of gaseous matter. The coarser range of vibratory influences acts upon the nerves through the medium of the ears, and the finer range through the eyes. Thus the body is like a highly delicate instrument, upon which nature plays with a thousand fingers, and which responds to the faintest touch of physical force, though it cannot act of itself any more than the piano can yield music without a pressure upon its keys.

But an important secondary result flows from this primary relation of organisms to outer nature. Contact induces oxidation. Nutrition follows. Growth takes place in the active regions of the body, but not in the passive. In the study of the genesis of the species particular attention must be given to this fact. The parts of the body which come most into contact with external substances, and move most readily in response thereto, are those which grow and vary most rapidly. This is particularly the case in the lowest animals, in which a developed nervous organization is yet wanting. In them contact induces motion in the contiguous surfaces. Local growth follows. Protrusion of sensitive and active tentacles results.

In the higher animals, in which a nervous system has been developed, a different result of external contact appears. The motion induced takes place at some internal point, and it is here that the subsequent growth occurs. Thus the influences which yield local growth in low forms mry be generally distributed throughout higher forms, and the great power which external nature has to mold the surface regions of the one, is reduced to a minimum in the case of the other. We may look upon external contact as first inducing a genesis of pseudopodia, tentacles and other motor appendages; and as next inducing a genesis of nerves, sensory nerve organs and muscles. A surface exposed to repeated touch both grows more sensitive to touch, and the energy received gradually makes its way inward, though protoplasmic channels. Every habitual touch either signifies some peril, or some other condition to which the organism must respond if its highest good is to be attained. The more readily it responds, the more varied its motions, and the more adapted they are to the good of the animal, the more likely is it to survive. Thus, though the nerve channels leading inward from a sensitive surface might take any direction, and induce a great variety of motions, yet those

running in the direction and inducing the motion best adapted to the good of the organism, will be eventually selected, and the others crowded out. If, then, the early local response to touch and outgrowth of li mbs or tentacles is followed by an evolution of nerves and muscles, out of the many possible directions of these nerves and positions of these muscles, those which are of advantage to the animal must be selected or the animal will perish.

In the higher animals, then, there is not, as in the lower, a special development of the parts directly exposed to contact. This method of development has been succeeded by a development of special channels of force inflow, and of muscles to which motion is principally confined. An impression received on one part of the body induces growth in another part, in which the affected muscle is situated. Yet it must not be supposed that all development of the touched surface at once ceases. It is not enough for the nerve to end upon the surface. It must have a peculiar termination, specially fitted to receive the contact influence of the external force. These contacts are of several distinct kinds, and each of them may be readily received by one form of nerve termination, but with difficulty by other forms. There is, therefore, a natural selection of nerve terminations, the animal best fitted in this respect having the advantage. Hence local growth of the parts of the surface exposed to touch is succeeded by local modification of those parts, to render them delicately sensitive to some special mode of touch. Development in response to force contact is at first local protusion of motor organs, then a gradual evolution of sense organs, nerve fibers and muscles, a conveyance of the contact energy inward from the point of its reception to some internal point, and a localization of motor activity and growth in internal regions of the body.

In the very lowest animals we find nothing to indicate the existence of even the rudiment of a mind. There is no retention of energy. Every excitation powerful enough to make itself felt is responded to by a reflex motion. We cannot fairly credit the Amœba with desire for food and definite motions towards food. More probably it moves only in response to external pressure, its movements becoming definite in direction only when this pressure is similarly definite. If this be the case then the taking of food is a chance result of motions without a fixed purpose. The

abundance of Rhizopod food, and the incessant motions of Rhizopods, are the two conditions through which the survival of these primitive life forms is attained.

But every motion has some modifying effect upon the constitution of the body. Response to any contact causes increased sensitiveness in the part affected. As the steel accepts magnetism most readily in the direction in which it has been formerly magnetized, so does the Amœba respond to contact influence most readily in parts that have been most frequently touched, and it repeats most easily the special motions it has previously made. Of the many motions and changes of form which may occur, those best adapted to food-getting will be selected, since the animals making them will survive while their competitors will perish. The various species of rhizopods indicate the various kinds of rhizopodal motion that have best succeeded in food capture. Evolution in this early stage is first the preservation and then the inheritance of such results of chance deviation as have proved successful.

The best adapted movements from danger are as important as the best adapted ones towards food. In the earliest life stages we might imagine that survival of ill-protected forms could result only from retrograde movements, or from excessive reproduction. It would seem as if protection by the formation of defensive armor should be a late result of evolution. Yet, on the contrary, armor is assumed by some of the lowest forms of life, the diatoms and various rhizopods. This result proves that the conditions for the assumption of defensive armor exist abundantly, and arise from some native characteristic of protoplasm. Nor need we go far to discover the cause of this effect. All active protoplasm absorbs and employs water. But the water absorbed contains lime and silica in solution. As the water is chemically employed these substances are precipitated, and are ejected from the body in their insoluble form. Here chance comes into place They may be washed away by the surrounding water. They may continue on the surface, the minute particles aggregating into a solid coating. Proving protective they are retained, and selection and inheritance act to the evolution of armored species. Very early, then, in the animal series evolution takes two directions. In one there is a naked body, trusting to quick motion for safety. In the other there is a coated body, trusting to armor

for safety. Another form of armor may begin in the chance clinging of sand to the jelly-like body. All such favored forms are sharply selected from the multitude of variations, and thus assume the definiteness of species. The intermediate, weakly-protected forms are crowded out.

The subsequent evolution of naked and armored forms must necessarily differ. The one becomes generally sensitive, gains varied motor organs, and becomes swift and diverse in its powers of motion. The other is sluggish and lacks sensitiveness. Sensation is confined to the unprotected parts, and it is these which develop into elongated organs of touch and movement. In the one food is obtained by swift approach, safety by swift retreat. In the other, food is usually obtained through currents made by cilia or tentacles in the water, safety by a withdrawal within the armor.

In all animals above the very lowest it is of importance that the surface should grow in some degree indurated. If the naked protoplasm were exposed freely to every contact there would be constant motion in response, and the energies of the body be uselessly and dangerously exhausted. The animals best adapted are those which have limited and partly protected parts of the surface alone exposed to the influence of the finer modes of force contact, while the protoplasm of the remainder of the surface is sensitive only to the more vigorous impacts.

Surface induration may take one of two forms. It may increase until the skin becomes a hard armor, to which the animal trusts more than to motion, it becoming heavy in weight, slow in movement and dull in sensation. Or it may end at a slight degree of induration, the animal being light in weight, quick in movement and sharply sensitive. Thus the two phases of evolution which appear in the lowest animals, reappear in the higher with similar results.

All protoplasm is sensitive to touch of all kinds, when exposed to it, but each separate kind of touch tends to develop conditions of appropriate sensitiveness. Excessive light causes a general development of dark pigment, probably as protective against heat effects through its active radiation. This aids absorption of the light rays, and is the condition preliminary to the evolution of the eye. Sound also tends to develop a receptive organ. The preliminary condition of this organ is the deposition of solid parti-

cles, which seem to collect the vibrations. In fact all the special senses make use originally of conditions which arise in the body as necessary or occasional results of its action, and which are subsequently developed by the incessant play of external force, into definite sense organs.

In the secondary development of nerves the incessant inflow of motor impressions renders some check important, since, as the sensitiveness of the body increases, a muscular response to every sense impression would totally exhaust the vital energies. This check takes place wherever the nerve fibers are reduced in size, the energy dissipating from that point, as electric energy dissipates in the form of heat when its conductor is too much reduced in size. This checked energy becomes growth force at the points of its dissipation; and nerve cells, aggregating into ganglia, appear at these points. In the higher animals a special region for the checking of sensory force is developed, the congeries of nerve cells there produced constituting the brain. The growth of the brain increases as sensitiveness increases and as the muscular response to impression is hindered, while the energies which outflow into the brain are stored up in some unknown manner, whose results we call the mind.

Thus external impression appears to yield several successive kinds of organic results. It first instigates growth at the immediate point of contact, and surface protrusions appear, in which reside the chief motor and sensory power. Secondly, the external energy forces its way inward, by conductive channels, and is discharged at internal points. Growth of muscular organs takes place at these points of discharge, and of sensory organs at the points of reception. Thirdly, the inflowing energy is checked at certain points on the nerve fibers, and instigates the growth of nerve cells at those points. Fourthly, the energy discharged in the principal ganglion causes the development of some special organism for its reception and organization. The energy thus organized we call the mind, its substantial basis the soul, but are ignorant of the nature of either. Such seem to be the successive results of external force impact. The other organs are similarly derived. The functions of digestion and excretion produce their growth results through pressure impressions upon a secondary system of nerves and muscles; the development of the vascular organs is a necessary accompaniment of that of the muscles and

ganglia; and the growth of the connective tissues may be instigated by muscular pull, gravitative pressure and other general force influences discharged into the body.

Thus there is some reason to believe that all animal growth and transformation is instigated, directly or indirectly, by the influence of external motor force, which penetrates the body, induces oxidation (which could not otherwise take place) and produces some phase of animal action, succeeded by an increased blood flow to the point of activity and a subsequent special nutrition. The indirect results of this principle—those of mental instigation—arise from previous individual or from ante-natal contacts, whose influence is stored up in the organism as a directive energy. The ante-natal contact influences tend to the development of the type; the individual to variations from the type, which grow decided when new forms of contact, arising from changed external conditions, act upon the body.

If we consider the life of an individual animal, it may seem as if the idea here advanced is not sustained. For the inherent physical and mental aptitudes of the body control its development far more than external influences. But what is the life of an individual? The aptitudes mentioned were derived from parents, who in turn derived aptitudes from their parents, and the parental line might be followed back, if we adopt the evolution hypothesis, through an excessively long series of animals until it reaches its source in the primitive speck of homogeneous protoplasm. The complete life history of an animal really includes the organic histories of all these precedent forms, though it be millions of years in the making; and the germ of every advanced animal is the record of an interminable era. But nowhere along the line will we find all the organic aptitudes which are displayed in the final form. These physical and mental characteristics were gradually gained. The original rhizopod did not have them. Whence, then, did the man obtain them? The original rhizopod was not without its inherent characteristics. It possessed chemical differentiations to which the difference of sex may be ascribed, and differences in the relations of its internal and external regions to which the separation of the motor and nutritive func-

[1] For illustrations of this fact see chapter on "the law of use and effort" in paper on "The Method of Creation of Organic Forms," by Professor E. D. Cope, Proceedings of American Philosophical Society, Dec. 15th, 1871.

tions may be ascribed. These characteristics of the lowest forms have had a constant influence upon the subsequent development, and vigorously control the evolution of structure in the highest animals. But all other organic characteristics must be due to the play of the fingers of outer nature upon the whole long line of progress. Nature has constantly surrounded and pressed upon the body with her varied energies, inducing responsive motions, growths and variations, and influencing every step of evolution. The most highly evolved body has been thus formed and molded, and possesses hereditary characteristics derived from its whole long line of ancestors. The same may be said of its mental strain. The mind receives and develops under the force of impressions received from without. There is no proof that it has any self-power of development. It began in a possibility, which has been wrought by outer nature into the existing actuality.

Each animal, then, has inherent conditions gained during ages of development by its ancestors. As an individual it is but slightly molded by exterior influences, its internal tendencies being too vigorous to be easily bent aside. But these tendencies arose from the action of exterior influences on its long line of parentage. Hence its whole development is virtually a struggle between external forces—those which play upon the animal during its short individual life, contending against those which have played upon and become inherent in it during its long ancestral life. It is as one impression contending against a million, and we can readily understand the stubborn resistance of the inherent organic conditions to external warping influences.

The influence of external contact upon life and development is strikingly seen in certain peculiar phenomena of the animal world. Vigorous as are the inherited tendencies, yet they are in some cases checked by the action of external conditions belonging to a lower grade of development. The Amphibia, which pass their first life stage as gilled water animals, do not attain their final grade of development if confined to the water. The tadpole that is forcibly kept in the water does not develop into a frog. Although inherently tending to attain this grade of development, it seems to need the contact of air with its surface to induce the necessary changes of organization. While exposed only to water contact nutrition proceeds without modification. The Axolotl, a gilled salamander, continues so if it remains in

the water, but becomes the lunged Amblystoma if it leaves the water. Reproduction takes place in the former stage, though it is partly larval. Various other instances of this character might be adduced. There are peculiar fishes, the Leptocephali, which, by deprivation of normal contact influence, seem to remain embryonic throughout life. They are small, pellucid, ribless, cartilaginous creatures, destitute of generative organs, which are found floating far out in the ocean. Gunther considers them to be the offspring of various marine fish, which represent an arrest of development in an embryonic stage. They have been exposed to abnormal conditions, and failed to receive the contact influence necessary to call into play the innate energies of development. It may be, then, that growth can proceed at any stage of life, but that for each new phase of development the animal must be exposed to new conditions of nature. It has in itself the inherited tendencies to successive phases of development until the highest is attained, but these remain dormant until set in play by the requisite kind of external contact.

If this be the case, every animal is, to a very marked degree, controlled by the influences of the outer world, growth, activity, variation, and the inherent development being all dependant upon the instigation of external energy. If we knew the various conditions to which the ancestral line of any animal had been exposed, and could reproduce those exact conditions with which to surround its offspring, its development might be arrested at various ancestral stages, and its line of evolution made out. The instances given of retarded development in Amphibia, are cases in point.

An animal species constantly surrounded by one unvarying set of conditions will not change. Any tendency to change will be restrained by lack of adaptation. Yet natural conditions vary not only in kind, but also in degree. Two animals occupying the same locality may be exposed to very different natural conditions. One is played upon by comparatively few of nature's influences, the other by very many, and the complexity of their adaptations to nature are in accordance therewith. Thus evolution may be of two kinds. One is a change in constitution to meet a change in climatic or other conditions. This produces no change in rank of development. A second kind of change may be either a progression or a retrogression. The animal becomes

adapted to simpler or to more complex conditions of nature, and the question as to whether a creature is higher or lower in rank depends entirely upon the degree of complexity in its adaptations.

Embryonic development closely follows the ancestral line. If there has been a retrogression, the point from which the fall commenced is always attained by the larva, as in the case of the barnacles and in other instances. But the successive changes of condition are not all clearly displayed. Some stages of development are retarded, others hurried through. It is probably a question of the influence of external conditions. Of the conditions of nature to which the various ancestral forms of the animal were adapted, many have vanished. Some yet exist. Thus in some stages of larval life the animal would find no support from nature. In others it is adapted to existing nature. The former stages are hurried or slurred over in development, the latter are passed through slowly. Of the many thousands of ancestral forms which the embryo might exhibit, the great mass succeed and overlap each other so rapidly as to be indistinguishable, while some persist as marked conditions of larval life.

And if the animal is forcibly retained under conditions favorable to one of its larval phases of development, its individual life may long continue in that phase, as in the cases above cited. The lives of intestinal parasites present marked instances of this kind. One phase of life is pursued for an indefinite period in one host. Yet as soon as another host is entered, and the animal exposed to new contact influences, and surrounded by new conditions, growth is succeeded by development, and a new life phase assumed. One instance of this is that of the Trichinia, which lays its eggs only in the intestine of its second host.

It would seem as if the conditions surrounding the larva strongly favored growth in that life stage, and hindered the innate tendencies to develop. For the latter to come fully into play, the animal must enter into the conditions necessary to its next life stage, or at least be withdrawn from active external influence, so as to permit the play of organic chemistry within its tissues, and the consequent unfoldment of new conditions of the tissues.

The facts of insect transformation present the most striking instances of the life process above considered. In the higher

animals, indeed, the conditions of embryonal life preclude the long retention of larval stages. The embryo here is fully developed within the body of the parent, or within the egg with its proper conditions of warmth and nutriment. There is no hindrance to a rapid development. But in many of the lower tribes the young is born and abandoned to the influences of outer nature while still in an early stage of embryonal growth. In its further process of development it must be exposed in some stages to advantageous, in others to disadvantageous conditions. Natural selection will act to lengthen the period of the former, and shorten that of the latter. The animal will develop irregularly, now remaining long in one phase, now hurrying rapidly through several successive phases. And the retention of any one phase of life is not simply an effect of natural selection, but also of the principle above enunciated, that the action of favoring external contacts tends to restrain the operation of the innate tendencies to development, and to promote simple nutrition and growth without change of organs.

In insect larvæ very active nutrition takes place. The tissues increase rapidly in size, but their further development is, for the time, arrested. Other important effects result. The animal whose life is arrested at the larval stage being exposed to all the molding influences of nature, gains specific variations similar to those which occur in mature animals. As the conditions to which the larva was originally adapted change, it changes in accordance. It gains special habits and organs necessary to its success in this stage of life, yet forming no part of its native plan of development. These are adventitious organs, and are thrown off by the animal in its pupal development as useless additions to the body. But the most marked and singular instance of this principle of growth occurs in another branch of the animal kingdom, the Echinodermata. There is nothing more remarkable in the history of animal transformations than that displayed in the development of the various members of the Echinoderm races. Yet these strange transformations are undoubtedly results of the principle of development here enunciated. Only the core of the true larva is indicated in the form of the swimming larva. It has gained many adventitious organs, probably as results of a long process of adaptation to conditions surrounding its larval life, but which are utterly outside its original life plan. Only the deep-

lying organs are in the true line of development. When development is resumed only these internal organs are retained as part of the mature animal, and the secondary larval organs are thrown off, or absorbed as nutriment by the new body. To so great an extent has this secondary development proceeded, that in some cases the discarded organs retain their power of swimming and devouring food, though with no means of digesting it. The energy of further development resides only in the core of the strange creature which has surrounded itself with a temporary shell of swimming, food catching and masticating organs. The tissues of the mature form are molded out of those of the larva, and its useless series of temporary organs discarded.

It would appear, then, that if any animal during its embryonal development enters, at any stage of this process, conditions favorable to the persistence of that stage, its further development is temporarily checked. The energy of outer influences resists the action of internal energies. Nutrition opposes development. The vigor of the organism is devoted to growth, and its energies of change are restrained. Many animals pass on to maturity without a halt. Others make several halts in the path of development, in each of which nutrition checks unfoldment. For development to be resumed, nutrition must be checked. The insect larva must cease to eat ere it can resume its life progress. It also seeks some shelter to secure it from danger during this process, this being probably an instinct arising from natural selection.

And now proceeds a series of organic changes, arising perhaps from the exercise of chemical affinities inherent in the tissues, by which the molecules of these tissues are rearranged and new forms of tissue produced, the nutriment stored in the form of tissue during the larval period serving as material for the new-forming tissues.

It is quite possible that in the embryonal development of all animals there are periods of active nutrition in which growth replaces unfoldment, and periods of quiescence and cessation of nutrition in which the chemistry of evolution resumes its activity, acting on the products of nutrition and molding them into new forms. In some cases these changes rapidly succeed each other. In others the period of larval restraint grows abnormally long. In such a case as that of the Aphis, the larva is so well provided with food that its further development is completely checked.

It reproduces by gemmation and continues larval through many generations. Only in autumn, when the conditions of nature grow unfavorable to its larval nutrition, do the long-checked energies of development assert themselves, and the final progress to maturity take place.

Marked instances of the same kind as those here considered appear in other fields of life, and notably in the Hydrozoa. Here as in insects we have species which progress directly to the mature or Medusa stage, while in others there are long periods of restraint in the larval stage, and of differentiation and reproduction of the larval form. In some cases the advancement to the Medusa stage is checked to such an extent that the free-swimming state is not entered, and occasionally only an aborted representative of the Medusa, or mature Hydrozoan, appears.

In all cases one thing is evident; the development of reproductive organs seldom occurs in the larval form,[1] and is always the last stage in the attainment of maturity. Though the larva represents a former mature animal possessing reproductive organs, it now fails to gain them, and such reproduction as it displays is always by gemmation. It is a nutritive not a reproductive organism. The production of the reproductive organs is the final phase of individual life. It is the signal that the animal has attained the apex of its individual life, and is about to continue its existence in the person of its offspring. Did these organs appear in the larva they would indicate a retrogression, since sexual offspring would be produced, and the final life stage fail to appear. Thus larval retardation effects a lengthening of the individual life, and in some insects constitutes the whole of the nutritive stage. In these cases no nutriment is taken in the imago state, and only sexual reproduction attended to.

The marked production of adventitious organs in Echinoderm larvæ leads to another thought. The modern theory is, that all animals in their progression from the germ to maturity pass through form phases indicating every ancestral type. But it would be useless to seek for detailed indications of the ancestral forms in the embryo, since probably only the core of these forms is reproduced. The general, deep-lying, essential features of structure are displayed, but not the special superficial organs. Only when, as in insect and echinoderm larva, development is retarded, do

[1] One case in which it does occur is that of the Amblystoma, above given.

these specific organs appear, to be secondarily modified through the influence of changed conditions of nature.

The question might here be reasonably asked, why, if the larval condition of the insect is often so superior to the imago for purposes of nutrition, did the animal ever advance to a more intricate life stage? Why did it not persist in its better adapted ancestral form. This question it may not be difficult to answer. There have been very great changes in natural conditions, and the relations of insect life have varied accordingly. Insects were, in all probability, the first flying animals. If so, the possession of powers of flight was a highly advantageous condition. It enabled the original insects to escape from their enemies on the land, and they had no foes in the air. At this period, then, there was probably no retardation in the larval stage, and the imago stage may have long continued. Such a condition persists in some species of insects. Later, however, the air became the home of other flying animals, and the insect lost the security which it had previously enjoyed. In the weaker and more exposed tribes, natural selection produced a lessening of the length of the imago life period, and a hastening of the reproductive activity. But as mature life was checked, larval life was lengthened. A certain degree of nutrition was necessary, and could now be more safely attained in the larval stage.

The same variation of conditions may have acted to produce the larval retardation of the Crustacea, the Echinodermata and other tribes. The soft-bodied and helpless Medusa seems particularly subject to danger from foes. In its original development it may have been much less so. A subsequent rapid destruction of the mature animals may have caused the development of the better protected colony of Hydrozoan larvæ.

Some final consideration of the method of developmental changes seems desirable. There are inherent in the germ energies and tendencies, chemical, molecular, or whatever we choose to call them, adapted to the complete unfoldment of the typical form. But, as appears evident, their operation can be checked by influences from external nature. There is a struggle between these contact influences and the innate organic energies. The latter are the resultants of numerous previous contacts which have acted on the whole ancestral line of the animal. The mind, in its inherited tendencies, represents these ante-natal forces. The action

of inherited instincts acts as a check to larval nutrition, and tends to bring the animal into conditions of quiescence and shelter in which its further development may proceed.

Probably the unfoldment of the mental conditions continues even while the animal is active in its larval nutrition. The new awakening instincts more and more vigorously oppose the existing habits. Eventually the instincts gain precedence, through some check to larval nutrition, active life ceases, and the animal process of growth is replaced by the vegetative process of organic synthesis. At the end of this period oxidation of tissue is resumed, and the animal starts again into active life, with new organs, new powers and new instincts.

Those insects which pass a period of individual nutritive life in the imago state are those which stand highest in the line of evolution, and highest of all are the ants and bees, in which larval activity and nutrition are largely obliterated, while the imago stage of life is long continued. The same may be said of all animal tribes. Long life after the reproductive organs appear is a sign of a high phase of evolution, and the habits and mental strain attained in this stage are superior, since they arise from the influence of more complex natural conditions.

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PEARLS AND PEARL FISHERIES.

BY W. H. DALL.

Part II.—Marine Pearl Products.

THE marine mollusks which chiefly produce the pearl and pearl-shell of commerce, are generally known as "pearl-oysters." They present little or no resemblance to the oysters with which we are familiar, though they are related to them biologically. They belong to the genera Avicula and Meleagrina of Lamarck, and are of three or four species, distributed nearly in the same latitude in different parts of the world. The most ancient and famous fisheries are on the coast of Ceylon and in the Persian gulf. These were known to Pliny; Ceylon by the name of Taprobane, and the Bahrein islands of the Persian gulf as the Stoides. Beside these the principal fisheries of the present day are on the Coromandel coast, India; the Indo-Pacific islands, especially the Sulu group; Margarita island, St. Thomas and other

places in the West Indies and Caribbean sea; Panama and the Gulf of California.

The chief fishery of Ceylon has its headquarters at Kondachai, on the eastern shore of the Gulf of Manaar, between the Island of Ceylon and the southern extreme of India. It has been controlled by the government from prehistoric times. In some respects the fishery is carried on exactly as it was in the time of the Romans; in the manner of regulating it and the disposition of the right to fish, a variety of methods have obtained since the time it has been controlled by Great Britain. This has been partly due to the fact that the fisheries fluctuate greatly in their product notwithstanding the immense wealth which has been derived from them for centuries. Thus, from 1732–46, 1768–96, 1820–28 and 1837–54, the fishery was either given up entirely or produced to the government less than the expenses of its regulation and inspection. On the other hand the revenue during the periods 1796–1809, 1814–20, 1828–37, 1855–60, was over five millions of dollars, and the value of the product not less than fifteen millions. In 1881 the government received a revenue of $300,000 from the fishery, the value of the pearls obtained being reported at one million dollars, exclusive of pearl shell.

These fluctuations are due partly to depopulation of the beds by over fishing and partly to the fact that the mussels, though usually attached by a strong fibrous byssus, have, when of moderate size, the power of migrating from one locality to another, of which they avail themselves when the turbidity of the water or other annoyance makes a locality distasteful to them.[1] Thus it is said that, owing to the filth discharged into the sea from the shipping and town of Tutikorin, on the Madras side of the straits, the oysters appear to be permanently abandoning that vicinity.

Two species of shells afford the pearls, the *Avicula margaritifera* Lam., sometimes called the "true pearl-oyster," and *Meleagrina margaritifera* Lam. The former is rarely larger than the palm of one's hand, is wing-shaped, rather globose and quite thin. It has the most brilliant nacre and produces the finest pearls. The shell itself is so thin as to possess no value as mother-of-

[1] C. f. Kelaart in Ceylon Calendar, 1858, Appendix; also Simmond's "Commercial products of the Sea," London, 1879, p. 414. This last mentioned work contains the most thorough and valuable compendium of information relating to sea pearls and pearl fisheries to be found in the English language, and has been frequently drawn upon for the purposes of this article.

pearl. The second species is much larger and thicker, nearly flat, and produces the most valuable pearl-shell as well as good pearls. Both species, with several local varieties, are somewhat widely spread over the Indian, Australian and Indo-Pacific seas. The beds and banks are annually surveyed to ascertain their condition. They are situated about twelve miles west of Ceylon, and extend some ninety miles parallel with the coast, consisting of calcareous or coral rocks covered with eighteen to forty feet of water.

The numerous changes which have taken place in the mode of letting and regulating the fisheries, have rendered it difficult to give a thoroughly accurate account of their present status. Most books of reference, such as the Encyclopædia Britannica and the descriptions of such authors as Frédé, are compiled from other accounts of different dates, and are therefore inaccurate and confused.

It has been the policy of the authorities in Ceylon to divide the beds and to allow only one fourth of them to be fished annually, thus giving each bed four years' rest. In earlier times seven years was allowed. But the objection to the system is, that, owing to the numerous enemies to whose attacks the shell fish are subject (and other causes), banks of oysters have been known to disappear almost totally within a single year when left unfished for more than three or four years. So while the temptation is very great to leave the beds untouched for a long period, in hope of securing a supply of large pearls, the danger that the whole may be lost, more than counterbalances it. The government is therefore proceeding experimentally to determine the most suitable length for the period of rest. Experimental divings made from 1875–8 showed that the banks then being fished contained some ten millions oysters. The average number of pearls to be expected is about two in one hundred oysters. The value per thousand of the oysters depends upon the size of the pearls. The theory is, that pearl-oysters in the last year of their existence double their value all round. If a thousand oysters produce pearls altogether worth $100, the catch is considered very good. One hundred as big as a pin's head are not worth one as big as a pea, so that the fishery is practically a lottery with a few prizes and millions of blanks. To give all an equal chance, the boats are selected by lot, sent out by turns in fleets of about fifty, each fleet in succes-

sion, until all have had an equal number of chances. About 250 boats are actually engaged, and 10,000 people directly or indirectly interested in the fisheries.

The fisheries begin early in March and last about six weeks, the weather and currents being at this time of the year most mild and suitable.

Each boat has its complement of rowers, five diving stones weighing about forty pounds each, and ten divers. Each boat and all the men are numbered, and the government shed or enclosure, in which the catch is placed on the return, is divided into similarly-numbered compartments, so that each man knows exactly where to put the result of his day's work.

The boats start about midnight in order to reach the banks by sunrise. As soon as the boats have arrived on the beds a signal gun is fired and the diving stones go over the side with a rumbling noise. Each stone is attached to its boat by a long cord with a little numbered buoy to mark it, and in a loop near the stone in this cord the diver puts his foot and is carried to the bottom, which otherwise his own buoyancy would hardly permit him to reach. The divers are all orientals of various nations, and go in pairs, one tending the cord while the other dives. The one on board watches the motions of his comrade, draws up the stone, then the basket of oysters collected, then the diver himself.

Ordinary divers remain under water fifty to eighty seconds, rarely much longer. It is related, however, that some have been able to remain as long as five minutes under the surface; this is probably an exaggeration. They seldom take any precautions against injury except to put a little oiled cotton in the outer ear. The most painful part of the operation is not the being obliged to hold the breath, but the sensation of great pressure to which the diver is subjected from the water. This in beginners often forces blood from the vessels of the mucous surfaces and even ruptures the drum of the ear.

They strip for their work. They have a girdle or a band around the neck to which a basket is attached, into which the shells are put as they are gathered. Into the girdle are stuck one or two spikes of iron wood, about a foot long and an inch in diameter. They are made very sharp at both ends and are for defense against sharks and rays. If a shark approaches the diver endeavors to thrust one of the spikes into his open mouth, which

in closing upon it transfixes the lips and renders the monster harmless.

Each pair of divers keep their catch separate from the rest, in large nets or baskets, so that luck and labor determine their reward.

They do not dive alternately, as too much time would be lost in changing. The man who has been down floats or holds to a rope at the surface a minute or two until rested, and goes down again until weary, when his comrade takes his place in the water. This continues without interruption until noon. The diver's pay is one-fourth the number of all the shells he obtains. The stimulus of self-interest thus brought to bear is so great that, as the time approaches for ceasing work the efforts of the men increase, and there is never so much activity as when the heat is most intense, the sun glaring fiercely and the sea like melted lead. At length the signal gun is fired, every stone goes down simultaneously for one more haul, and then the fleet makes at once for the shore. When they reach the beach, in an instant the divers are in the water and each pair carries the results of the day's work to the shed. In two hours, unless delayed by adverse winds, the boats are unloaded. At the shed the oysters are divided into four heaps. The divers remove their heap, the three heaps belonging to the government are left in the shed, the total is assorted into piles each containing a thousand oysters, the doors are locked, guards stationed and everything is ready for the public auction sale. This system, says Simmonds, from whom the details are mostly derived, brings to bear upon the daily results of the fishery the largest amount of private interest and the smallest amount of government control. No man could be forced into doing what the divers do voluntarily; no fixed payment would induce them to dive so often in the day, or to unload their boats with equal dispatch. Their exertions are necessarily very violent, and the divers as a rule are short lived. The oysters are sold in lots of one thousand; formerly in smaller numbers, as twenty to fifty, or a hundred. As really fine pearls are as scarce as really fine diamonds, of a hundred people who buy, eighty suffer a loss, or at least make no profit. If the government or the subcontractors risked their profits on the actual yield of pearl and pearl shells obtained by their boats, many of them would be ruined, as was formerly the case. But by taking

advantage of the tendency to games of chance inherent in the oriental mind, the losses, if any, are distributed among a large number of petty traders.

The shores of the Gulf of Kondachai present, during the season of the fishery, a remarkable assembly which has been graphically described by Percival, Frédé and others. A floating population of ten to fifteen thousand is attracted by the opportunity for speculation and trade. These protect themselves from the night air by tents and temporary huts as near to the landing-place of the boats as possible. When the afternoon gun proclaims the return of the fishing fleet, a motley crowd rushes to the shore to meet it. The contractors or sub-lessees, usually dark, keen-looking Parsees or Malays, hail their boats in half a dozen languages to learn the result of the day's work; Hindoo sorcerers, who, for a consideration will chain the appetite of the shark and send the diabolical sting ray on an errand to Bombay; jewelers of high and low degree, from the millionaire of Benares to the itinerant peddler who fashions you a ring out of a half sovereign before your eyes; vendors of cakes, confections, rice, dates, fruit, lentils, ghee and barbarous varieties of pies; all crying their wares at the top of their lungs in twenty different dialects; Merry Andrews, jugglers, gymnasts, tamers of wild beasts and serpents; Singhalese, Malays, Hindoos, Papuans, Africans, Kanakas, Arabs, Englishmen; honest, brown Marava sailors in full dress of a breech clout and earrings; yellow Chinese in flowing nankin robes, most acute of bargainers, most adroit of thieves.

The country away from the beach is low, sandy and barren, abandoned during a large part of the year and at no time inviting. Along the margin of the strand stretch heaps upon heaps of dead and refuse shells, the accumulation of centuries. With the blue Indian sea to the west, with myriads of tents, often rich in color and valuable in fabric, for a background; the white government buildings, the motley booths, the fleet of myriad oriental boats rocking gently on the summer sea, and the seething crowd in and about it all—the scene is perhaps unique even in the "sunrise-land."

The description, however, would be inadequate if it omitted to mention the horrid exhalations which infect the air from tens of thousands of decaying shell-fish, thrown into the sea only to be

cast again upon the sands; from the refuse of a thousand little camps and fifteen thousand unregulated barbarians; so that an European is forced to saturate his beard with rum or his handkerchief with some disinfectant if he would even go near enough to view the extraordinary spectacle. Added to these outrages upon the sense of smell, are swarms of gnats, mosquitos and fleas, to say nothing of the innumerable poisonous insects which run upon the ground, and the deadly serpents which infest the shrubbery.

The shell-fish are allowed to die, the shells then open naturally, the pearls are extracted, the Avicula shells thrown away, the Meleagrina shells preserved for export as "mother-of-pearl." These are known to commerce as "silver-lipped" pearl shell. Their nacre is very clear and bright, the shells attain the largest size of any, sometimes eighteen inches, so that a pair of this size open will extend a yard from edge to edge. The finest come, not from Ceylon but from the Sulu sea, and are worth from $400 to $700 per ton. The diver who collects a hundred shells per day in fifty feet of water does a good day's work.

So far the divers of Ceylon have refused to avail themselves of submarine armor and several attempts to use the diving bell have resulted in failure, chiefly from the irregularities of the bottom and the small area which was accessible to those in the bell.

After the pearls are collected they are classed, weighed and valued. To class them they are passed through a succession of brass cullenders called "baskets," of the shape and size of large saucers. There are ten or twelve of these baskets; the first has twenty holes in it and the pearls which do not pass through after being well shaken, are called of the twentieth basket. The succeeding baskets have 30, 50, 80, 100, 200, 400, 600, 800, 1000 holes, and each basket gives its name corresponding to the number of holes to the pearls which reach but do not pass through it. The pearls which do not pass through the eleventh and twelfth baskets when these are used, are called *masie*. The pearls having been sorted as to size by means of the baskets, are carefully examined as to shape and color, and each size except the *masie* is susceptible of seven distinct descriptions. After being classed they are weighed and valued according to their respective qualities. The price of pearls is expressed at a certain rate per *chow*, which term has reference to the resultant of all their characteris-

tics. The number of pearls which are valuable for jewelry and permanently retained for such uses is quite limited, the majority of the small and defective ones are used in a medical preparation highly prized in oriental countries, and of which I shall have more to say hereafter.

The official reports of the importation of pearl and pearl shell into different countries, which are the only sources of information toward estimating the product, are meagre and doubtless quite inaccurate. I find that the average imports of pearls per annum, for ten years, into Great Britain, were $260,856.50; into France only $39,294.32, which is somewhat surprising. Of pearl shell or "mother-of-pearl," the average annual value imported into Great Britain during sixteen years ending with 1870, was $237,-500, nearly as much as the pearls, and in all probability at the present time, when the demand for art purposes has much increased, the importation value of the shells is greater than that of the pearls.

A brief reference to the pearl fisheries of the Bombay coast of India and of the Persian gulf will not be devoid of interest.

The finest pearls are obtained from the Persian gulf, but most of them pass into oriental countries. The fisheries are chiefly on the Arabian side of the gulf and are entirely in Arab hands. The intrusion of foreigners into the business would produce a popular tumult. There are four thousand or five thousand boats employed along the entire coast, averaging twenty-two men to a boat. Being whiter than the divers of Ceylon, they blacken their bodies when diving that they may be less conspicuous to sharks. The product of the fishery is estimated at $2,000,000 per annum, of which half comes from the Bahrein islands, which were known to the ancients as the locality of a rich pearl fishery, under the name of the Stoides. The great bulk of the best yellowish pearls are purchased by natives of Bombay. A large number of pearls are sent to Bagdad, where the white ones are preferred. At the time when the Ceylon fishery was unproductive, the largest proportion of pearl shell and pearls imported into England were from this fishery. The shells are known as "Egyptians," as they are shipped from Alexandria.

There is, or recently was, a pearl industry about Kurrachee, on the Bombay coast, for which the native contractors paid the local government a royalty of $20,000 per annum. The statement is

made in the Encyclopædia Britannica that the pearl product of this vicinity is obtained from shells thrown on the beach by the surf, which seems improbable. However the pearls are chiefly seed pearls, too small to be of use in jewelry but employed by the orientals in medicine. The powder of pearls is supposed to have the virtue of strengthening weak eyes, and to be efficacious in palpitations, hemorrhages, nervous and other affections. A similar notion, doubtless derived from the Arabian physicians was prevalent in Europe during the middle ages and may still be found in pharmaceutical works of the last century. The gilded youth of India, Persia and "Araby the Blest" indulge in the luxurious extravagance of substituting powdered pearl for lime in the mixture of betel and areca nut, which they are accustomed to chew.

The fisheries of the Sulu sea, Labuan and the Society islands are productive, but offer no special peculiarities except the employment of women as divers in certain localities. As these ladies are accustomed to supply their husbands with crabs and other sea delicacies from an early period of their existence, by diving for them, the transition is easy to pearl diving. They are also said to be more steady and reliable than men, a virtue due doubtless to the rigid discipline enforced by their lords and masters.

Magnificent pearls are obtained at the Gambier and Paumotu islands and the western and northern parts of the Australian coast have lately been coming into notice as the source of a valuable and growing pearl and pearl shell supply. Ten years ago these fisheries hardly existed, and but few statistics are available in regard to them.

The native divers of this great Indo-Pacific region are said to dispense with stones or weights. However, here as elsewhere, the limit in time spent below water seems to be about a minute and a quarter, and the limit of depth about twenty fathoms. Divers will seldom go so deep, however, and the average does not exceed ten fathoms.

The pearl fisheries of the west coast of America are supplied from beds in Panama bay (now nearly extinct), and others in the Gulf of California, of *Meleagrina californica* Cpr. The shells are smaller and thinner than those of the *M. margaritifera*, and have the technical name of "Panama" or "bullock-shell." They are

valued at $90 to $125 per ton. The gulf beds in the seventeenth and eighteenth centuries were very prolific. Eight hundred native divers were regularly employed, and the annual value of the pearls was $60,000. The fishery became exhausted, however, and was gradually abandoned. Of late years it has looked up again, and the Mexican government has farmed out the beds to private parties who have been in the habit of granting licenses to persons provided with the equipment for fishing. This method ignores the preservation of the beds as such, and each licensee endeavors to strip them as thoroughly as possible. Rubber armor is used, and natives of Central America are employed as divers. Even with these appliances the work is attended with risk, and deaths are not uncommon. About three tons of fresh shells are obtained by an ordinary party per day from water about forty feet deep when the weather is fair. About one shell in a thousand contains a pearl, but these are often of excellent quality. The natives work on shares of the pearls; the shells go to the vessel's account. The working season is about three months. In 1882, 563 barrels of these shells were shipped from San Francisco to Liverpool by sea, but this is only a small part of the catch, which is usually shipped by coastwise steamers to Panama and thence to Europe.[1] The pearl fisheries of the Caribbean sea are more productive than those of the west coast, though still much less so than in former times. The species which constitutes them is chiefly the *Meleagrina squamulosa* Lam., known to the trade as "blue-edged" or "black-lipped" pearl shell. Of these most of the so-called "smoked pearl" buttons are made. The dark layers of the shell, present in most pearl oysters, are thicker and brighter in this species than in any other. The shells are worth $150 to $225 a ton. They are found on several of the West Indian islands, the northern coast of South America and even around on the coast of Brazil. The island of Margarita, off the Venezuelan coast, is famous for its pearls. In 1597 about 350

[1] Since writing the above the following item has come to my notice: Some remarkably large pearls have been obtained, during the last fishing season, at the fishery near La Paz, in the Gulf of California. One found in December,—the largest on record from this region,—weighing 75 carats, sold on the spot for $14,000, and is considered to be worth much more. Another very perfect one, of 47 carats, is valued at $5,000; and a third at $3,000. It is many years since such good fortune has attended the divers of this region, though the product of pearls of moderate size has been tolerably constant.—(*Mex. Financero*, Jan., 1883).—*W. H. D.*

pounds of pearls were brought to Spain from these fisheries. In 1574 Philip II obtained a pearl from Margarita which weighed 250 carats and was considered to be worth $150,000. At present the fisheries, though vigorously prosecuted, produce fewer large pearls, and the best are considered not quite equal to the best oriental pearls, being of darker color. To the ordinary method of procuring the shells by diving they add a wooden frame set with curved spikes which scratches the shells from rocky bottoms and brings them up somewhat like a rake. In 1856 the pearl products imported into England from all parts of this region were valued at $112,000.

Enough has been said of the fisheries, and before closing we may devote a little attention to the pearl in its literary, historical and artistic relations.

Classical and ancient authors, treating of natural history, make numerous references to pearls. Athenæus states that in the Indian seas a shell named *berberi* is found containing pearls, which are sold in Persia for their weight in gold. This would be a small price for a good pearl in our days. Pliny and Dioscorides asserted that the shell which produces pearls remains during the breeding season with the valves open and expanded at night. Thus they receive drops of dew from which pearls are conceived according to its quality. If the dew is pure the pearls which are produced from it are of lucid whiteness, which correspond in size to the amount of dew received. If the dew is impure the pearls are dull or muddy. According to these authors the shell fish are afraid of thunder, and instantly close when they hear it. To this is due the occasional conception of hollow pearls, containing no substance. While in the sea, they assert, the pearl is soft and tender, and hardens on being taken from it. These myths are of Indian origin.

Pliny thought that pearls came to their complete size and form in a month from the time the oyster received the dew at the surface of the sea. This poetic fancy of the ancients, in regard to the origin of pearls, has found expression more than once in modern verse. Perhaps the most elegant rendering is contained in the following lines of Archbishop Trench :

> "A dewdrop, falling on the ocean wave,
> Exclaimed in fear, 'I perish in this grave!'
> But, in a shell received, that drop of dew
> Unto a pearl of wondrous beauty grew;

And, happy now, the grace did magnify
Which thrust it forth (as it had feared) to die;
Until again, 'I perish quite,' it said,
Torn by rude diver from its ocean bed.
Vain apprehensions! soon it gleamed a gem,
Chief jewel in a monarch's diadem."

In later times, with a nearer approximation of the true cause, the older naturalists attributed the origin of pearls to disease. In explanation of it they told that the waters on the coasts where pearls were fished for were very unhealthy, and that the natives there would not eat the flesh of those oysters which contained pearls, regarding them as diseased, hard and ill-tasted, while those in which there were no pearls were well flavored and comestible. These notions appear to have had their basis in fancy only.

Pearls are mentioned in the New Testament in several places, but only once in the Old Testament,[1] though other versions of the story of the Queen of Sheba speak of her dress as adorned with pearls. The oldest use of pearls was doubtless by prehistoric people. Their remains, still recognizable and brilliant, but ready to fall into powder, have been found in prehistoric mounds and burial places in both hemispheres. It is doubtful, however, if they would attain any very great antiquity in such situations, being very perishable; and we read of the pearls worn by the daughters of Stilicho[2] when, in 1526, after more than 1100 years, their tomb was opened, the contents, jewels and stuffs, all were found in perfect preservation except some pearls which were reduced to extreme brittleness.

The Assyrians and Babylonians are said to have highly valued pearls, with which they became acquainted through their intercourse with the peoples bordering on the Persian gulf. They were little known in Greece until after the defeat of Darius, when many were found in the plunder of his camp. Later still the Romans prized them highly, and transmitted them to their children as heirlooms. The importance of the person was indicated by the size of the pearls she wore, and Pliny intimates that a large pearl was thus as good a protector for a woman walking in the street as a lictor walking before her. Pompey brought from

[1] Math. VII, 6; VIII; XIII, 46. I Tim. II, 9. Rev. XVII, 4; XVIII, 12, 16; XXI, 21. Job XXVIII, 18.

[2] Roman general under Theodosius; died A. D. 408.

his campaigns in Asia thirty head-bands of pearls, which he gave to the temple of Venus which already possessed a few. Pearls are spoken of as gifts made by Alexander Severus to his empress, and by Julius Cæsar to Servilia, the mother of Brutus. In the days of the decadence of the Roman empire pearls became a very common ornament in Rome among the wealthy classes, and were worn in great profusion, even upon the sandals, a practice reprobated by St. Paul (1 Tim., ii, 9).

The story of the pearl dissolved by Cleopatra must be relegated to the domain of fable. No vinegar would dissolve a pearl of large size except after long maceration, and the acid which would perform it quickly would be absolutely undrinkable. That Cleopatra possessed a fine collection of pearls is doubtless true, since one large one, captured by the Romans, was sawed in two to form ear-pendants for the Capitolian Venus.[1]

The Persians have always been great admirers of pearls, frequent references to them appear in their literature. Hafiz, who wrote in the fourteenth century, has this beautiful simile, which might be applied to his own verse:

> "Whose accents flow with artless ease
> Like Orient pearls at random strung."[2]

To come to more modern times we may note that the Sultan Solyman the Magnificent, in the sixteenth century, presented to the Republic of Venice a pearl valued at 200,000 ducats, which is supposed to be the same as that bought afterward from a Venetian jeweler by Pope Leo X for an immense sum. The Moors of Grenada used strings of pearls in repeating verses of the Korán, as Christians used rosaries.

The largest pearl formerly known in Europe once ornamented the hat of the King of Spain. It was brought from India in 1620 by Francis Gogibus, and was of great beauty but somewhat defective form. The Shah of Persia, in 1633, according to Tavernier, paid for a single pearl $65,000. This pearl was one of the most celebrated in Asia and had belonged to the Sultan of Aden who obtained it from a merchant of Benares in exchange for three hundred horses of pure Arab blood.

According to Frédé pearls were little known in France until the time of Henry II, and Catherine de Medici.

[1] Cf. Frédé, Voyage etc., 1882, for an interesting résumé of this subject.
[2] Sir William Jones' translation.

One of the most celebrated pearls in Europe is that called La Pellegrina, in possession of the Zosima Museum at Moscow, which has been the subject of several publications. It was bought fifty years ago from the captain of an India ship at Livorno, in Italy, and is perfectly spherical and of such brilliance and purity as to appear almost transparent. It weighs about ninety grains, and may be considered the most beautiful pearl known. The imperial crown of Austria is ornamented with a pearl of three hundred carats weight but of mediocre quality.

The best known and most perfect large pearl of recent times is that belonging to the collection of the late Mr. A. J. B. Hope, M.P., of London. It weighs three ounces, is an inch and a half in diameter and two inches long. Its value is estimated at about $60,000. The most usual dimensions of fine oriental pearls is from one and a half to three times the size of a pea.

Each locality produces pearls of especial tint or character; Japan and Celebes are noted for rosy pearls; the Gambier islands for those of a bronze hue, derived from the hammer oyster (Malleus); the Gulf of Mexico for black ones; the Marianne archipelago for a very rare greenish kind; the Gulfs of Persia and Manaar for the pure white orient pearls. Two pearls of a ruby red, found in the waters of Ceylon over a century ago, are said to be in the hands of the Rajah of the Sulu isles. These are said to be of great beauty, but no more have ever been found, though some of our American Naiades produce rosy or pink pearls. Pink and rosy concretions of great beauty but not nacreous and therefore not true pearls, are produced by the queen conch (*Strombus gigas* L.) of the West Indies, and *Turbinella scolymus* L. of the East. These lose their color in course of time, as do the shells from which they come, and true pearls never do.

It may be noted that pearls like most animal products, however hard, are occasionally subject to a sort of decay, or *malaise*, with loss of brilliancy and consequent loss of value. A good preventive against such evils, is to keep the pearl, when not in use, in magnesia. Pearls should not be put in greasy or soapy water, nor subjected to contact with acids, such as the juices of fruit or vinegar. If constantly worn fluctuations may occur in their brilliancy and tone due to differences in the exhalations from the wearer's skin, which may result from changes of temperature, illness or emotion.

I may terminate this review of these exquisite organic products by a pretty tale from the Talmud, teaching us that the people of that day esteemed but one object in nature of higher value than pearls.

It tells us that when Abraham approached Egypt he locked Sarah, his wife, in a chest that none might behold her beauty. But when he came to the place of paying customs the officer said to him, "Pay custom." And he said, "I will pay the custom." They said to him, "Thou carriest clothes;" and he said, "I will pay for clothes." Then they said, "Thou carriest gold;" and he replied, "I will pay for gold." On this they cried, "Surely thou bearest the fine silk;" and he answered, "I will pay custom for the finest silk." Then they said, "Surely it must be pearls that thou takest with thee;" and he only answered, "I will pay for pearls." As they knew of nothing more valuable than pearls, they demanded that the box should be opened in order that it might be determined what concealed treasure it was for which the owner was willing to pay customs even as for fine pearls. And the box was opened, and then, as now, beauty and virtue, idealized in woman, were acknowledged of earthly treasures to be as pearls of great price.

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CATLINITE.

Its Antiquity as a Material for Tobacco Pipes.

BY EDWIN A. BARBER.

"From the redstone of the quarry
With his hand he broke a fragment,
Moulded it into a pipe-head,
Shaped and fashioned it with figures;
From the margin of the river
Took a long reed for a pipe-stem,
With its dark green leaves upon it;
* * * * * * *
And erect upon the mountains,
Gitche Manito, the mighty,
Smoked the calumet, the Peace-pipe,
As a signal to the nations."

Hiawatha.

For many generations the native tribes of the United States have procured a highly-prized material for the manufacture of their tobacco pipes at the Great Red Pipestone quarry, situated on that

portion of the dividing ridge between the Minnesota and Missouri rivers, denominated by the early French settlers, *Côteau des Prairies.* There has been some discrepancy in the statements of travelers in regard to the exact location of this source of aboriginal supply. Carver informs us that near the Marble river "is a mountain, from whence the Indians get a sort of red stone, out of which they hew the bowls of their pipes."[1] Dr. Charles Rau, in an article entitled "Ancient Aboriginal Trade in North America," quotes from Loskiel,[2] principally in reference to the pipes of the Delawares and Iroquois: "Some are manufactured from a kind of red stone, which is sometimes brought for sale by Indians who live near the Marble river, on the western side of the Mississippi, where they extract it (*sic*) from a mountain." Du Pratz erroneously located the quarry "on the bank of the Missouri,"[3] but, for obvious reasons, he was, in all probability, misinformed by the natives.

Catlin, who was the first white man permitted by the Indians to visit the place, describes it as being situated between the St. Peters and Missouri rivers, "in a direction nearly west from the Fall of St. Anthony, at a distance of three hundred miles."[4] According to Dr. C. A. White, the quarry lies in Minnesota, about thirty miles from its south-western corner, and three or four miles from its western boundary.[5] Dr. F. V. Hayden, who visited the locality some years ago, writes of it as follows: "On reaching the source of the Pipestone creek, in the valley of which the pipestone bed is located, I was surprised to see how inconspicuous a place it is. Indeed, had I not known of the existence of a rock in this locality so celebrated in this region, I should have passed it by almost unnoticed. * * * * * The pipestone layer, as seen at this point, is about eleven inches in thickness, only about two and a quarter inches of which are used for manufacturing pipes and other ornaments. The remainder is too impure, slaty, fragile, &c. * * * * A ditch from four to six feet wide and about five hundred yards in length, extending partly across the

[1] Travels through North America, Dublin, 1779, p. 95.

[2] Smithsonian Report, 1872, p. 372.

[3] Ib. p. 369.

[4] Illustrations of the Manners, Customs and Condition of the North American Indians. Ninth ed., London, 1857, p. 171, Vol. II, Letter 54.

[5] Vide AMERICAN NATURALIST, Vol. II, p. 644.

valley of Pipestone creek, reveals what has thus far been done in excavating the rock."[1]

Professor I. N. Nicholet observes: "This red pipestone, not more interesting to the Indian than it is to the man of science, by its unique character, deserves a particular description. In the quarry of it which I opened, the thickness of the bed is one foot and a half; the upper portion of which separates in thin slabs, whilst the lower ones are more compact. As a mineralogical species, it may be described as follows: Compact; structure slaty; receiving a dull polish; having a red streak; color blood-red, with dots of a fainter shade of the same color; fracture rough; sectile; feel somewhat greasy; hardness not yielding to the nail; not scratched by selenite, but easily by calcareous spar; specific gravity 2.90. The acids have no action upon it; before the blow-pipe it is infusible *per se*, but with borax gives a green glass."[2]

Dr. C. T. Jackson, of Boston, to whom Catlin sent specimens, pronounced it a new mineral, and gave to it the name of *catlinite*.

The Great Red Pipestone quarry of the North-west has been the theme of some of the most interesting myths of the North American Indians. Aside from the testimony of early eye-witnesses of the customs of the native tribes, some of these legends, which have been handed down through many successive generations, in various portions of the United States, would seem to indicate that the material had been employed in pipe-sculpture for a considerable length of time. Nearly all of these traditions of the Sioux, Mandans, Knisteneaux and other tribes,[3] as narrated by Catlin and other writers, while they differ somewhat in detail, appear to be simply modifications of Longfellow's version, as embodied in his "Song of Hiawatha." In addition to savage mythology, facts are not wanting to prove the comparative antiquity of the aboriginal operations at *Côteau des Prairies*. "There are indications," says Dr. Hayden, "of an unusual amount of labor on the part of the Indians in former years to secure the precious material."[4]

The narratives of many of the early writers contain allusions to catlinite. The Jesuit missionary, Marquette, who smoked the pipe of peace with the Indians as early as 1673, describes the imple-

[1] *Am. Jour. Sci. and Arts*, Vol. XLIII, Jan., 1867, p. 19.

[2] Senate Doc. No. 237, Twenty-sixth Congress, Second Session, 1840–'41.

[3] See Wilson's "Prehistoric Man," London, 1862, Vol. II, p. 11, et seq.

[4] *Am. Jour. Sci. and Arts*, Vol. LXIII, Jan., 1867, p. 20.

ment as being "made of a polished red stone, like marble, so pierced that one end serves to hold the tobacco, while the other is fastened on the stem, which is a stick two feet long, as thick as a common cane, and pierced in the middle; it is ornamented with the head and neck of different birds of beautiful plumage; they also add large feathers of red, green and other colors, with which it is all covered."[1]

The red stone to which this writer alludes was, in all probability, the pipestone of Minnesota.

"The pipe of peace," remarks Carver, "which is termed by the French, the calumet, for what reason I could never learn, is about four feet long. The bowl of it is made of *red marble*, and the stem of it of a light wood, curiously painted with hieroglyphics in various colors, and adorned with the feathers of the most beautiful birds."[2]

"This *Calumet*," writes Father Hennepin, "is the most mysterious Thing in the World among the Savages of the Continent of the Northern *America;* for it is us'd in all their important Transactions: However, it is nothing else but a large Tobacco-Pipe made of *Red*, Black or White Marble: The Head is finely polished, and the Quill, which is commonly two feet and a half long, is made of a pretty strong Reed or Cane, adorn'd with Feathers of all Colours, interlac'd with Locks of Women's Hair. They tie to it two Wings of the most curious Birds they find, which makes their Calumet not much unlike Mercury's Wand, or that Staff Ambassadors did formerly carry when they went to treat of Peace. They sheath that Reed into the neck of Birds they call Huars, which are as big as our Geese, and spotted with Black and White; or else of a sort of Ducks who make their nests upon Trees, tho' water be their ordinary Element, and whose feathers are of many different Colours. However, every Nation adorns the *Calumet* as they think according to their own *Genius* and the Birds they have in their country."[3]

Mr. John F. Watson, in his "Annals of Philadelphia," quotes

[1] Dis. and Ex. Miss. Val., by J. G. Shea, New York, 1852. Father James Marquette's Narrative, p. 35.

[2] Carver's Travels, Dublin, 1779, p. 336.

According to Mr. Shea, "We are probably indebted to Father Marquette for the addition to our language of this word" (calumet). (Dis. and Ex. Miss. Val. Note p. 21.)

[3] A New Discovery, etc., p. 93. London, 1698.

Quoted by Col. C. C. Jones in "Antiquities of the Southern Indians."

from the work of the Swedish traveler, Professor Kalm, in reference to the Indians, preceding the year 1748: "The old tobacco-pipes were made of clay or pot-stone, or serpentine stone—the tube thick and short. Some were made better, of *a very fine red pot stone*, and were seen chiefly with the sachems."

During the last century catlinite pipes were in general use amongst the various Indian tribes of the United States. The recent historians devote considerable space in their works to the description and illustration of these characteristic aboriginal productions.

Schoolcraft figures a number of Dakota pipes, one of which represents a tomahawk and another is a curious pipe with two rectangular bowls,[1] one placed behind the other and entirely distinct. Catlin has also published many sketches of calumets which he saw in his travels. He also made an interesting collection of these objects, which fell into the hands of the indefatigable collector, Mr. Wm. Bragge, F.S.A., of Birmingham, England (which collection I learn has been recently sold), in which was an unfinished bowl from the quarry, a pipe in the form of a canoe, a Pawnee catlinite pipe representing a buffalo cow in front of the bowl and a calf at the back, and weighing nearly three pounds—in all a series of thirty specimens, many of them beautifully inlaid with metal.

The red pipestone is still much sought for by the modern Indians, and pipes of this material are common amongst the Santees, Poncas, Apaches, Comanches, Sioux, Cheyennes, Arapahoes, Utes and, indeed, almost all the tribes east of the Rocky mountains. In nearly every public and private ethnological museum of any importance, modern examples occur, but these are generally inlaid with lead, silver, tin or some other metal, and frequently show the influence of civilization in their designs, being made in imitation of iron hatchets, spear-heads, knives, the heads of horses or other objects, animate or inanimate, of European introduction. A fine specimen of the horse-head form, elaborately inlaid with lead or pewter, is now in the museum of the Davenport Academy of Sciences, and a somewhat similar example, made by the Da-

[1] See "The History, Condition and Prospects of the Indian Tribes," Part II, pl. 69.

Dr. C. S. Arthur, of Portland, Ind., owns a double-bowled catlinite pipe very similar to that mentioned above, but possessing an upright ridge on the horizontal neck.

kota Indians, I procured from Professor E. H. Crane, of Colon, Michigan, who informs me that this tribe employs over seventy-five different patterns in pipe manufacture, of which the *calumet* is the only form for which they evince any degree of veneration in their ceremonies. This traveler saw the Indians take the material from the quarry and subsequently fashion it into pipe-bowls. The process of making catlinite pipes employed by the Sioux at the present day, is thus described to me by Mr. Chas. H. Bennett, of Pipe Stone City, Minnesota: A piece of the rock is selected from the best portion of the vein and the Indian sculptor, with an old piece of hoop iron, or a broken knife blade which he has picked up, fashions the block roughly into the desired form. Then slowly and tediously, with the same tools, he bores out the bowl and the hole in the stem, before carving the exterior, so that if, in the process of boring, the stone should split, no labor will be lost. After this is accomplished he shapes the surface into any design which he may have in view. This work often occupies weeks before it is completed, after which the carving is polished by rubbing it with grease or oil in the palms of the hands. Some of the more elaborate examples are inlaid with silver, lead or type-metal in the following manner: The portions to be inlaid are first cut out of the surface and a strip of heavy paper, first moistened, is wound tightly around the carved portions. Through a hole in the paper the melted metal is poured in until it fills all of the spaces. The wrapping is then removed and all of the uneven surfaces of metal rubbed smooth. These inlaid portions represent bands around the bowl or stem, or are made in stars, circles or geometrical devices, which give to the pipe a very ornamental appearance. Fig. 1 represents a carved pipe, two-thirds of the size of nature, which was sent to me by Mr. Bennett, made by a celebrated pipe maker belonging to the Flandreau Sioux. The material of this specimen is the purest and finest which I have ever seen, the color being a beautiful deep red.

According to Professor N. H. Winchell, of Minneapolis, the Chippewa Indians, at the present time, inlay the gray pipestone with red catlinite to produce a showy effect. One of these, in the famous Bragge collection in England, is made of dark stone inlaid with white metal *and catlinite*, from Pembina, Minn.

One of the finest catlinite pipes of recent date was owned by the celebrated chief of the Sacs and Foxes, Keokuk, which was

formerly the property of Dr. E. H. Davis, of New York, but is now in the Blackmore Museum at Salisbury, England. This is figured in the first volume of the "Smithsonian Contributions to Knowledge," on the 230th page, though it is there represented less than half the size of the original, while another illustration of it in *Harper's Monthly Magazine* for June, 1855, is further reduced in size, and is placed with three of the celebrated ancient mound pipes of Squier and Davis, beneath which occurs the simple legend "Indian Pipe-bowls."

The long stems of the calumet, which have, for many genera-

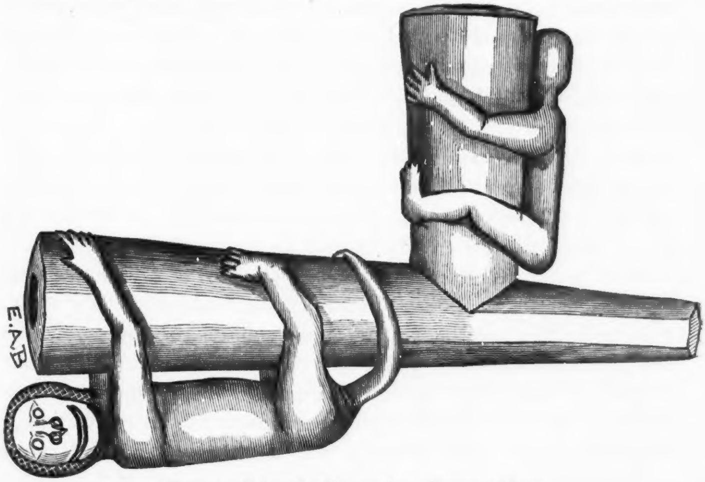

FIG. 1.—Calumet with carving of ape and boy.

tions, played such important parts in the wars, treaties and religious ceremonies of the Indian tribes, deserve a passing notice. Modern examples are often ingeniously made and profusely decorated with stained feathers, porcupine quill wrappings, bead work, human hair, gaudily-colored cloth and other ornamental trimmings. Specimens in my own collection are twisted and the spiral edges of the wood ornamented by charred designs. One flat stem in the collection of the Davenport Academy of Sciences is beautified with carvings of hearts and arrows which pass entirely through the center of the broad side. The stem hole which, if straight or following the pith, should intersect the open spaces, evidently passes around them; we are at a loss to know how such a result could be reached with the tools at the command of the

native workman. A stem belonging to a pipe from one of the Western Territories, in the collection of Philip Sharples, of West Chester, Pa., is closely wrapped with plaited moose hair, which is ingeniously stained in various colors with geometrical devices and representations of men and women. Another example presented to the writer by John H. McIlvain, of Philadelphia, is similarly ornamented with narrow braids of plaited porcupine quill-work, and was at one time the property of Eagle Head, a Sioux chief in the vicinity of the Falls of St. Anthony. The latter specimen was formerly in the old Peale Museum of Philadelphia. According to Mr. C. H. Bennett, the Indians in producing the twisted stems, which are generally made of ash wood, "cut a long strip of paper or cloth, wind it spirally about the stick and then cut along the edges of the wrapping. The hole is of course burned out with hot wire."

In olden times, as tradition has it, the Great Pipestone quarry was held as neutral ground where hostile tribes "buried all their warlike weapons" and peacefully met together to secure the gift which the Great Spirit had provided for their mutual benefit. Latterly, however, the territory, which includes the *Côteau des Prairies*, has been monopolized by the Sioux, and other tribes have only been able to procure the valued commodity by barter. A few years ago Professor Crane saw three hundred Yankton Sioux on their annual pilgrimage to the quarry, for the purpose of obtaining material to supply their own demands and for exchange with other tribes. Mr. Bennett, who has devoted much attention to this subject, writes me as follows: "The Yankton Sioux have no title or patent to the one mile square reserve, farther than that stipulated in the treaty made by Government with them about thirty years ago. The treaty is still in force, and the right of the Indians to dig pipestone for making pipes will belong to them as long as the treaty holds good. A gentleman of Minneapolis claims the west half of the mile square which has the pipestone diggings and the falls on, and is the most valuable part, through a patent erroneously issued by the Government a number of years since. The old head chief, Padanipapa or *Strike-the-Ree*, says he saw 6000 Indians camped at the quarry for two months about forty years ago.

In regard to the antiquity of catlinite as a material for pipe manufacture, there is a great diversity of opinion. Some writers

believe that the pipestone quarry was not opened before the commencement of the present century, whilst others agree with Mr. George Catlin in the belief that the natives were familiar with the peculiar properties of the stone and worked the quarry in far remote times. Professor Crane is of the opinion that pipestone has been extracted from this locality for many centuries, basing his belief upon the discovery of catlinite objects in ancient mounds in connection with other relics of undoubted antiquity. He assures me that he has found large quantities of chips and small fragments of red pipestone scattered over the country in the vicinity of Sioux falls, Dakota, and was told by an aged man of considerable intelligence that the latter had opened a mound in that neighborhood, a few years ago, in which he discovered a catlinite pipe of the oldest mound form. Be this as it may, recent investigations have proved beyond doubt that this material has been employed by the Indians for a much longer time than has been generally supposed. A century or so ago, long, cylindrical, opaque glass beads of a dark red color were made, in imitation of catlinite, and were imported to the United States in large quantities for traffic with the natives. These have been found in great abundance in certain localities, as in Lancaster county, Pennsylvania, and in Montgomery county, New York, and other portions of the Eastern States. The idea of furnishing such objects was suggested to the early traders by the catlinite tubes or perforated cylindrical ornaments which were common amongst the Indians, and which were highly esteemed by them. The glass imitations soon superseded the native stone productions to a great extent and doubtless proved a profitable source of income to the importers of Indian trinkets.

Indian graves in Chester County, Pa., have produced some curiously fashioned catlinite beads, some of them shaped in imitation of barbed arrow-points and others four-sided tubes upwards of an inch in length.

A considerable number of catlinite pipes have been taken from graves, and also from some of the older tumuli. In the ethnological collection of the Smithsonian Institution are several pipes and ornaments of red stone which were found in Indian graves in the State of New York while digging the Oriskany canal. The Peabody Museum of American Archæology and Ethnology contains several minute pipes made of catlinite, which were discov-

ered by Mr. E. Curtiss under a cairn in Marion county, Kansas. Professor J. D. Butler, of Madison, Wisconsin, refers to a pipe recently presented to the Wisconsin Historical Society, by Ole Rasmussen, which was found in Waupaca county in 1880, at a depth of twenty feet beneath the surface of the ground, while digging a well.[1]

From a large number of such pipes, which have been brought to my notice, I have selected a few of the most striking forms for illustration in this paper. A catlinite pipe in the collection of Mr. A. F. Berlin, of Allentown, Pennsylvania, is represented in Fig. 2.

FIG. 2.—Pipe from Stark county, Ill.

This specimen was plowed up in a field in the vicinity of a mound near Elmira, Stark county, Ill. When found it was entire, but falling into the hands of the children of the finder, two pieces were broken from the edge of the broad horizontal disk which rests on the rectangular base. This pipe, which is carved from a single piece of stone, although not unique in form, may be considered a rare type. The illustration is nearly the size of nature, the basal portion measuring one and three quarters of an inch in length. The stem was fitted in by wrapping the end to fill the large orifice, which is scarcely less in diameter than the mouth of the bowl, which latter was doubtless designed to hold but a small quantity of tobacco, adulterated probably with other herbs, which, inhaled in the manner peculiar to the Indians, required but a small quantity to produce exhilaration or intoxication. Two other pipes of the same material and almost identical in form, are in possession of Dr. C. S. Arthur, the disks measuring four inches in diameter. In one of these a portion of the stem is carved in the semblance of an animal with one head, two bodies, two tails and six legs.

[1] See *Am. Antiquarian*, Vol. III, No. 2, p. 141.

Mr. J. P. Jones, of Keytesville, Missouri, possesses an example (Fig. 3) somewhat similar in shape to the preceding, with the ex-

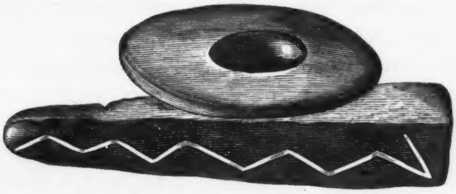

FIG. 3.—From a tumulus in Boone county, Mo.

ception that the platform is extended beyond the disk and tapers to a rounded point. A scroll or zigzag ornament is incised on either side. This specimen was taken from a small burial mound in Boone county, Mo. Another pipe, made of hard sandstone, of a somewhat analogous, but modified form, was found in Chariton county in the same State, and is owned by the same gentleman.

A pipe made of a light-colored stone, almost identical in form with Fig. 2, is in the collection of Mr. G. S. Mepham, of St. Louis, Mo. This was taken from a mound near Greenville, Illinois (see also Fig. 195, p. 49, Archæol. Collections Nat. Mus., Rau).

Mr. Charles C. Jones, Jr., of Augusta, Georgia, remarks in his excellent work on the Indians of that State: "Thus far the writer has failed to discover a single instance of the use, among the Georgia Indians, in ancient times, of the genuine red pipestone or catlinite."[1] In a recent communication, however, he sends me a sketch of a small catlinite pipe, found in May, 1877, on the right bank of the Savannah river, in Columbia county, Georgia. Fig.

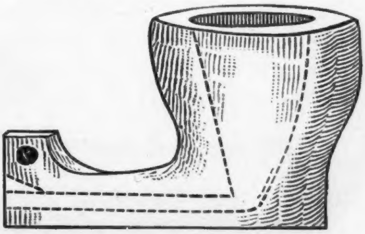

FIG. 4.—From Columbia county, Ga.

4 represents the object in its actual proportions. "In the same locality," writes Col. Jones, "was picked up a large cylindrical

[1] "Antiquities of the Southern Indians," p. 407.

bead, fashioned of the same material. In November of last year (1880), in the fork of the Patoiligo and Flint rivers (Southwestern Georgia), was obtained an oblong cylinder of catlinite, two and a half inches long and a half inch in diameter. It is perforated longitudinally, the diameter of the hole being nearly the quarter of an inch. Near one end occurs also a transverse perforation."

Dr. Charles Rau sends me a drawing of a pipe of unusual shape, which he mentions in his paper previously referred to.[1] "Its material," he writes, "is the real *catlinite* from the *Côteau des Prairies*, in Minnesota—dark red with lighter spots. The exact shape is shown in the accompanying drawing (see Fig. 5), which represents the object in its natural size. The pipe, however, is flattish, exactly half an inch thick in the middle. The drawing, of course, shows the broader side. The cylindrical cavity for holding the smoking material measures three eighths of an inch in diameter, and reaches five eighths of an inch downwards, when it suddenly becomes much narrower until it joins the lateral stem hole. The latter is nearly three sixteenths of an inch in diameter. It is the smallest catlinite pipe I ever saw, and, moreover, the only one of that shape known to me. It was ploughed up in a maize field near Centreville, St. Clair county, Illinois, and was sent to me eight or ten years ago, by Dr. John J. R. Patrick, of Belleville, in the same State and county."

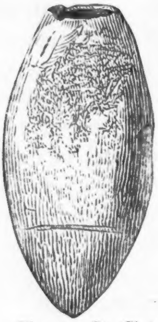

Fig. 5.—St. Clair county, Ill.

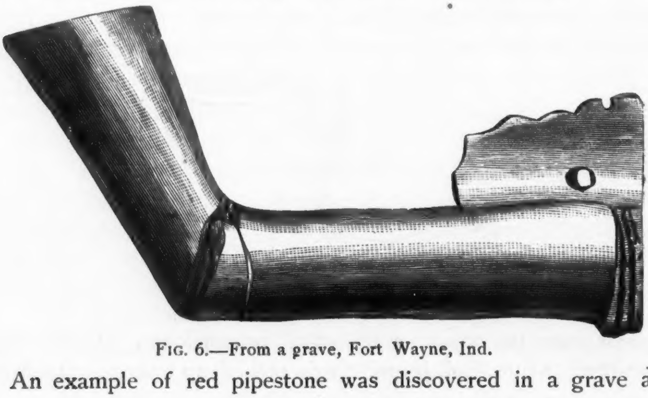

Fig. 6.—From a grave, Fort Wayne, Ind.

An example of red pipestone was discovered in a grave at

[1] See Smithsonian Report, 1872, p. 372.

Fort Wayne, Indiana, and is now owned by R. S. Robertson, Esq., of that city. It is represented in its actual size in Fig. 6. The form, while more modern than some of the other specimens figured, is not common at the present day. A few miles east of Fort Wayne, in Allen county, a curious pipe of the same material was found on the surface of the ground, a few years ago, which is now in the possession of Mr. H. J. Rudisill, of Riverside, California. A full sized drawing of this specimen is given in Fig. 7, and it will be seen that it is somewhat analogous in form to the interesting pipe described and figured by Mr. Henry Gillman, of Detroit, in his excellent paper on the " Mound-builders and Platycnemism in Michigan,[1] on which the figures 1697 have been scratched by some white man. The specimen illustrated in Fig. 189 in the "Smithsonian Contributions to Knowledge," No. 287, by Dr. Rau, belongs also to the same class. A pipe of similar form, but made of a gray stone possessing a reddish cast, is owned by R. W. McBride, Esq., of Waterloo, Indiana. As there is some doubt concerning the material of this specimen, it has not been figured here, although it has been pronounced catlinite by archæologists who have seen it. It was found on the surface, some years ago, on the present site of Waterloo. Another example in the same collection is given in Fig. 8. The material is supposed to be catlinite, it was taken from a mound in Putnam county, Ohio, about fifty years ago, by Dr. Jonas Emanuel. The head, which exhibits considerable artistic skill, is two and three quarters inches in height. The eyes and mouth are gouged out to a considerable depth, and may originally have contained pearls or nuggets of metal.

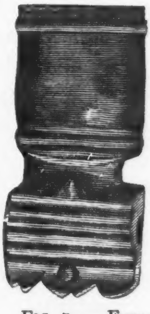

FIG. 7. — From Allen county, Ind.

Mr. S. Z. Landes, of Mount Carmel, Ill., has a catlinite pipe which was recently found beneath the roots of a tree which had been undermined by the waters of White river, near that place. The bowl is plain, but on the upper portion of the horizontal neck an animal resembling a weasel is carved in high relief. It was found associated with copper ornaments, leaden bullets, a copper kettle, a physician's lancet and an iron box filled with mica.

FIG. 8.—From a mound in Putnam Co., Ohio.

[1] See Smithsonian Report, 1873, p. 369.

According to the report of Long's expedition to the Rocky mountains, published in Philadelphia in 1823, the old Philadelphia Museum contained at that time "many Indian pipes of that indurated clay found only (as far as hitherto known) on the Pipestone branch of the Little Sioux river of the Missouri; one of these, however, *was found on the banks of the Rio de la Plata, in South America;* several were found in the territory now called New England, and in the north-eastern part of the continent." Unfortunately the specimen alluded to as having been found in South America, is probably lost, as the collection has long since been dispersed. It is, therefore, impossible, at this late day, to substantiate the statement quoted above.

Through the kindness of Professor W. H. Pratt, of Iowa, I have been enabled to procure photographs, sketches and accurate descriptions of a most interesting series of catlinite pipes belonging to the museum of the Davenport Academy of Sciences. A careful study of this collection reveals two important facts: First, that catlinite is not always distinguished by a red color, but that varieties sometimes occur of brown, slaty or greenish hues; second, that the forms of some of the older pipes, when considered in connection with the circumstances of their discovery, would indicate a much longer acquaintance with this material, on the part of the North American tribes, than has hitherto been supposed probable. The set of *modern* Indian pipes in this collection comprises specimens of a bright red color, others of a dark red or brown, and several of an ash or darker slate color, sometimes approaching a greenish tinge. As the red color has generally been considered one of the distinguishing characteristics of catlinite, some doubt might naturally be entertained as to the identity of the material of the latter, were it not for the fact that there are examples in the collection which are partially red and partially ash colored, and which are undoubtedly true catlinite. Such specimens combine in one piece the characteristics of several varieties of the stone, and present a mottled or variegated appearance. "In 1838," remarks my informant, Mr. Pratt, "*Little Crow* made a pipe while stopping a day or two at the house of Mr. Pope, then living near Fort Snelling, and presented it to the latter. It is of the dark ash color, and closely resembles some of our specimens in color and texture, but somewhat darker than any of them, and not in the least red. It is of the common modern form

and is inlaid with lead." This pipe has been presented to the Academy, and the material is pronounced catlinite.

In addition to the recent pipes, the Davenport Museum contains "four red, three partly red and partly ash colored, and twelve wholly of ash color, but running in some to a slate color, considerably darker," all but three of which have been taken directly from mounds, and those three found in their immediate vicinity. One of the most interesting specimens of these earlier forms yet brought to my notice, is the wild-cat pipe, from the Toolesboro' mound, represented in Fig. 9 (museum No. 4558)

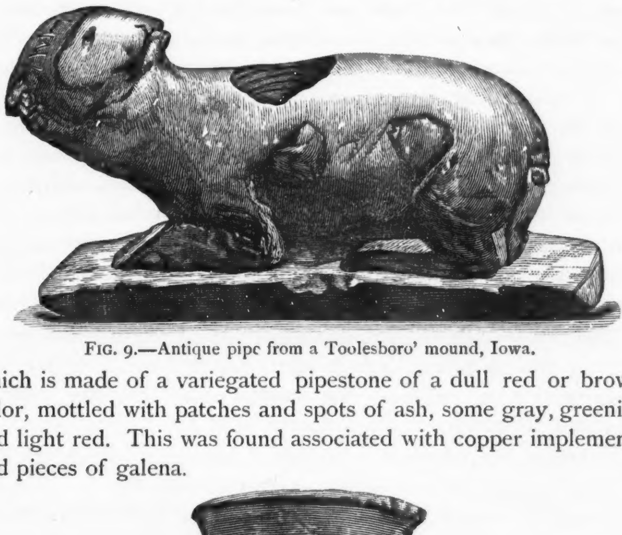

FIG. 9.—Antique pipe from a Toolesboro' mound, Iowa.

which is made of a variegated pipestone of a dull red or brown color, mottled with patches and spots of ash, some gray, greenish and light red. This was found associated with copper implements and pieces of galena.

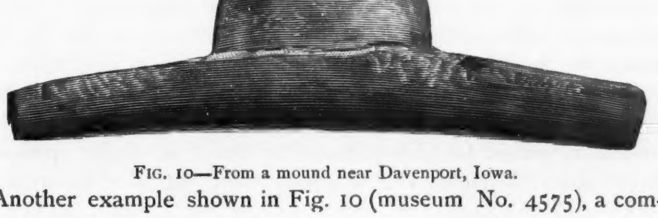

FIG. 10—From a mound near Davenport, Iowa.

Another example shown in Fig. 10 (museum No. 4575), a com-

mon form in the oldest mounds, is made of a very dark red pipestone, polished, from an extensive mound in Rockingham township, six miles south-west of Davenport. Three other specimens from mounds in Louisa county, Iowa, belong to Mr. C. T. Lindley, but are at present deposited in the same museum. One is a bird-shaped pipe of a bright dark red color; another is also of the bird form, but is of a solid gray color; the third is also gray and plain.

Dr. C. A. White, in a recent letter to Mr. Pratt, writes: "You are quite right in supposing that some portions of the pipestone from the Great Red Pipestone quarry are of an ash or similar color, while other portions are spotted or mottled, or both. The prevailing color is red, the color so commonly seen in pipes, and the light colors are rather rare. It is not improbable that the layer which furnished the best material for pipes may have been found at certain local spots to have had a lighter shade than the prevailing color, so that there might at certain times have been more of that color found than the whole deposit will average. In short, so far as color is concerned, I do not know why all the specimens you refer to may not have come from the Great Red Pipestone quarry."

After a thorough study and comparison of the various specimens of this collection, both modern and ancient, Mr. Pratt assures me that beyond doubt the material of all the pipes alluded to or described above is true catlinite.

A human headed pipe four and a half inches in length and three in height, in the collection of Hon. Horace Beach, of Prairie du Chien, Wisconsin, was found in a mound at Des Moines, Iowa. The form, however, does not indicate a very high antiquity; the specimen belonged doubtless, to an intrusive burial. Half of the platform and the head, which is situated near one end, is of a dull reddish color, whilst the other half of the base is a dark olive brown with a greenish tinge. The line, showing where the two colors unite, is very distinct. After a careful examination of this specimen I unhesitatingly pronounce the material catlinite. Another pipe bowl from the same collection is fashioned from a bright olive colored variety of catlinite, in which numerous small spots of a lighter color are visible. This pipe was taken from a mound in Prairie du Chien, Wis. Mr. Beach is of the opinion that it was a Winnebago production, belonging to a secondary

burial, the material probably being obtained from the northren part of the State. A third example, belonging to the same gentleman, is a very diminutive pipe, an inch in length, shaped in imitation of an Indian moccasin. It was evidently intended to be used without the intervention of a movable stem or mouth-piece, the material being apparently catlinite of a dark reddish-brown color, the stem orifice passing through the toe. It was found near Fond du Lac, Wisconsin.

Henry G. Clay, Esq., of Philadelphia, has a catlinite pipe made in the semblance of a bear's paw, with inlaid ornamentation. Mr. H. F. Sibley, of Fairfield, Ill., is the possessor of a catlinite calumet which measures six and a half inches in length. It was found in Minnesota. Another example in the same collection is a diminutive pipe which was discovered in a cave in Kansas. In a group of mounds in Rock Island county, Illinois, at a depth of seven or eight feet, were recently found two other pipes made of the dark red pipestone. One of these is unfinished, having no perforation leading to the bowl. The other possesses a round bowl with the head of an animal, somewhat resembling a mouse, carved on one side. In the latter specimen the eyes of the animal are not indicated, and the stem hole does not reach entirely through the bowl. These two last-mentioned examples have been placed in the Davenport Academy.

Amongst nearly two hundred pipes, discovered by Squier and Davis in a small sacrificial mound in Ohio, were many " composed of a red porphyritic stone, somewhat resembling the pipestone of the Côteau des Prairies, excepting that it is of great hardness and interspersed with small, variously-colored granules." When it is known that catlinite becomes hardened by long use and exposure to fire, there are strong reasons for believing that the " red porphyritic stone," several times mentioned in the " Ancient Monuments of the Mississippi valley," was in reality a variety of the true red pipestone. Some of the limestone pipes had been entirely calcined by the heat " which had been sufficiently strong to melt copper.

In support of the assertion that catlinite often occurs of colors other than red, Professor Crane writes me that he has taken specimens of this material from the great quarry which are pure white, and also pieces exhibiting every shade of color between this and deep red, including an ash-colored variety. A series of speci-

mens of the stone, which he procured at the quarry, and which he has sent to me for examination, includes a large number of varieties, differing considerably in density, some pieces resembling clay in softness, and others approaching jasper in hardness. In this selection specimens are found of a light buff or rich cream color; others present the various shades of red, whilst some are of a dark ash or slate color. Pebbles of great hardness, which were found in the drift close by, present the same diversity in coloring, and one example, of a deep red hue, is beautifully mottled with circular spots of a lighter shade. Many of the specimens of pipestone are variegated with small spots of a lighter or pink color, while others are buff on one side and flesh colored or dark red on the other. Says Dr. Hayden: "This rock possesses almost every color and texture, from a light cream to a deep red, depending upon the amount of peroxyd of iron. Some portions of it are soft, with a soapy feel, like steatite, others slaty, breaking into thin flakes; others mottled with red and gray."[1]

An examination of the several varieties of the stone, however, shows us that the deep red portions of the pipestone stratum are the finest in quality and best adapted for pipe sculpture, which fact will account for the prevalence of pipes of this color.

It has hitherto been generally supposed that catlinite was only found in one contracted locality—at the Great Red Pipestone quarry; but varieties of the same mineral occur at several points in Dakota, Minnesota and Wisconsin. Dr. White writes of it as occurring at Sioux falls, Minnehaha county, Dakota, where it is "intercalated with the red quartzite." Mr. Pratt informs me that the largest specimen block of red pipestone in the Davenport cabinet is from Blue Earth river, about seventy-five miles east of the quarry, and Professor J. D. Butler describes a pipestone, almost identical with the catlinite of *Côteau des Prairies*, which occurs in Sauk county, and also in Brown county, Wisconsin, at the head of Green bay. Professor N. H. Winchell, the Minnesota State geologist, writes Mr. Pratt that real catlinite is also found, *in situ*, at several points in Minnesota, in Pipe Stone Rock, Cottonwood, Watonwan and Nicollet counties, and sparingly at Pokegama falls. He also mentions it as occurring at the Great Palisades, in Dakota and in some parts of Wisconsin. Dr. Hoy, of Racine, states that "there is quite an extensive quarry of catlinite in the

[1] *Am. Jour. Sci. and Arts*, Jan., 1867, p. 20.

northern part of Wisconsin; color a little darker than the western variety; some specimens are dark ash colored." According to the Geological Report of Wisconsin for 1877, pipestone occurs also in considerable quantities in Barron county.

It will thus be seen that the native pipe makers were not limited to one particular locality to procure their material. It is not to be supposed that all of these deposits were known to them in olden times, but detached fragments might have supplied them with material in many places. It is highly probable that pipestone has been used by the inhabitants of North America for centuries, and was perhaps obtained at first in small pieces from the drift of the Missouri and Dakota valleys, long before the Great Pipestone quarry was worked and previous to the discovery of the stone *in place*. According to Dr. White,[1] ledges of catlinite are found in the north-western corner of Iowa, and the red quartzite which overlies them is found scattered in boulders as far as the Missouri State line, a distance of over two hundred miles. Professor Chamberlin, State geologist of Wisconsin, writes, in a letter to Mr. Pratt, "Catlinite occasionally occurs in our drift."

In reviewing the facts thus briefly stated it will be seen that the stone of *Côteau des Prairies* and the adjacent territory must have been employed by native sculptors for several centuries at least, and, in all probability, for a much longer period. The early writers frequently allude to a peculiar substance commonly used by the Indians in the pipe manufacture, which without difficulty may be identified as catlinite. There can be no doubt that an extensive traffic was carried on in this material for a considerable length of time by the aboriginal tribes, extending from the Atlantic coast to the Rocky Mountain system, and from New York and Minnesota on the north to the Gulf of Mexico. The fact that objects of catlinite have been taken from Indian graves in the State of New York, and that others were found on the ancient site of an abandoned village in Georgia, at opposite points, twelve hundred miles distant from the pipestone quarry of Minnesota, reveals the great extent of intercommunication which formerly existed amongst the North American peoples. When we consider the fact that many pipes of catlinite have been taken from the bottom of mounds from four to seven feet deep, where they were found in connection with cloth-wrapped copper axes

[1] AMER. NAT., Vol. II, p. 644.

and other objects of a high antiquity, and that some of them are of the typical form of the oldest mound pipes, viz.: A cylindrical or sculptured bowl rising from the center of the convex side of a curved platform, we are forced to believe that their age is very considerable.[1]

It is highly probable that future investigations may point to a still greater antiquity of the art of fashioning objects in pipestone than has been positively assigned to it in these pages, and, indeed, it is within the range of possibility that the aboriginal operations at the Great Pipestone quarry may be proved to have antedated the Spanish discovery of America by many centuries.

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EDITORS' TABLE.

EDITORS: A. S. PACKARD, JR., AND E. D. COPE.

——The unification of geological nomenclature, and of the system of colors used for geological maps, are two objects which the International Congress of Geologists has proposed to accomplish. So far as the nomenclature of the formations is concerned, the only *doubles emplois* which occur, and which are likely to occur, are to be found in the different names given by geologists to the same formation when they exist in different continents. Such duplications are not very numerous, but they are sufficiently so to demand attention. The only attempt in this direction of unification with which we are acquainted, is to be found in the first volume of the *Comptes Rendus* of the Congress, Paris, 1868.[2] It was there maintained that while the lesser sub-divisions of the formation of Europe and America can rarely be identified, those of primary and secondary grade are often clearly the same, and should bear the same name on both continents. The general adoption of the uniform nomenclature may be greatly facilitated by its recommendation by the Congress of Berlin.

A general uniformity in the system of geological coloration has long prevailed, but in detail there is much discrepancy. At present there are three principal systems in use: those of the committees which reported to the Congress of Bologna; that of the United States Geological Survey, and that of the Geological Sur-

[1] For other objects of pipestone not described here, see proceedings of the Davenport Academy of Sciences, Vol. I, pl. IV.

[2] Comparison of the horizons of extinct vertebrata of Europe and America.

vey of Canada. The considerations which should guide the final selection of a uniform system, must be—first, availability for practical use ; and second, the extent to which any given system has already been perpetuated in existing cartography.

The important condition first mentioned obviously includes the presentation of a sufficiently large number of sufficiently distinct colors or patterns, to include all the minor geological divisions which have been, or are to be, discovered. From this standpoint the plans sent in by the committees to the Congress of Bologna are very defective. Their authors apparently forgot that Europe constitutes but a small part of the world, and that the system to be adopted must represent America, Asia, Africa, and Australia The United States system, devised by Powell, is much better in this respect. A combination of this with the European scheme would do very well for the continents where they originated, but we suspect that even this combination would not be sufficient for the entire world. A larger list of colors and pattern variations even than that offered by Powell, will be required when the geology of the world comes to be known. In using them, also, care must be observed to allow vacancies for the undiscovered formations, and only paleontologists will be able to furnish indications as to where these are likely to be intercalated.

—— In an editorial of May, 1881, we referred to the desirability of a meeting of the British Association for the Advancement of Science, in America in 1883. The proposition to meet here in that year was not adopted by the association, but it has determined to meet in Montreal in 1884. The Allan line of steamers has offered extensive facilities to the visiting members, and the hospitalities of Montreal have been freely proffered. A large number of members have signified their intention of availing themselves of this opportunity of visiting our continent.

It is desirable that the meeting of the American Association, held the same year, shall be fixed at such a time as will enable the visitors to attend it also. The locality should not be remote from Montreal, and should be of easy access. An invitation will probably be sent from Philadelphia, the birth-place of the American Association. Should this be accepted our British friends may expect a warm and appreciative welcome. The Academy of Natural Sciences, the American Philosophical Society, and the Franklin Institute have appointed committees to take the matter in charge.

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RECENT LITERATURE.

WHITE'S NON-MARINE FOSSIL MOLLUSCA OF NORTH AMERICA.[1] —In this work the palæontological student has for the first time

[1] *Department of the Interior, U. S. Geological Survey.* J. W. Powell, Director. A review of the non-marine fossil Mollusca of North America. By CHARLES A. WHITE. Extract from the annual report of the director of the U. S. Geological Survey, 1881–82, Washington, 1883. Large 8vo, pp. 144, 32 plates.

a connected view of a most interesting assemblage of fresh-water andbrackish-water mollusks, belonging for the most part to a transition period of great scientific interest, that between and connecting the Cretaceous and Tertiary periods, *i. e.*, the Laramie. Dr. White first takes up each family in systematic order and traces the history of its occurrence so far as it has been learned, from the earliest known appearance of any of its species within the present limits of North America until the present time, with a general discussion of certain questions suggested by the facts stated.

The author claims that the Laramie group is a transitional one between the Cretaceous and Tertiary. "Neither the Laramie group nor any true geological equivalent of it is at present known anywhere except in Western North America. It there occupies or is found at various localities within a large region, the present known limits of which may be roughly stated as extending from Northern New Mexico on the south to the British possessions on the north, and from the vicinity of the Great Salt Lake on the west to a present known distance out upon the Great Plains of more than two hundred miles from the eastern base of the Rocky mountains. It has been traced within the western boundary of both Kansas and Nebraska." The history of this controverted group is then given, and for the benefit of the general reader a brief sketch of the evolution of the North American continent is then given in the following words:

"The continent in its present shape has been produced by the coalescence of two or more principal portions, which were elevated above the level of the sea in the earlier geographical [geological] ages in consequence of the progressive elevation of the continental area. The two principal portions of the continent previous to the Cretaceous period were an eastern and western one respectively, and before the close of that period they were separated by a broad stretch of open sea. By the continued slow rise of the whole continental area this broad stretch of open sea became land-locked at the close of the Cretaceous period and beginning of the Laramie, changing the area thus inclosed to a brackish-water sea, in which the strata that we now call the Laramie group were deposited. By the continued elevation of the continental area that sea became much reduced in size, and entirely fresh at the close of the Laramie period. During the immediately succeeding Eocene Tertiary epoch at least, the great fresh-water lakes that were thus formed prevailed over a large part of that area, which in the Laramie period had been occupied by brackish and previously by marine waters. Then began the series of movements in the earth's crust which resulted in the elevation of the plateaus and the great systems of mountains of Western North America into the structure of which these Laramie and Eocene strata enter. Some portions of the western part of the

continent continued to be occupied by fresh-water lakes of the kind last referred to during the middle and latter portions of the Tertiary period, but they were much less in size than those which previously existed. They also gradually became smaller, and finally disappeared by being drained of their waters, or remnants of them remained to become the salt-water lakes of to-day."

After a review of all the species, including the few Devonian, Carboniferous, Jurassic and Triassic, and Cretaceous species, the bulk of the review is devoted to the Laramie species. Each species is well illustrated by excellent drawings. In conclusion the author suggests, that as lakes are only parts of unfinished river systems the great western Laramie and Tertiary lakes on becoming obliterated were succeeded by rivers whose channels finally became, in part at least, the river channels of the present day. Some of the tributaries of the present Mississippi River system "are identical, at least in part, with former outlets and inlets, or both, of the great ancient lakes which have just been referred to. Consequently we may reasonably conclude also that the molluscan fauna of the Missisisppi River system is lineally descended from the faunæ of those ancient lakes, and the river systems of which they constituted lacustrine portions."

Farther on he says: "The coalescence of separate minor drainage systems by the confluence of their lower portions into a common channel, during the progressive elevation of the continent, has also been an important means of the dispersion of fluviatile mollusca. By such coalescence what were once separate rivers, or minor drainage systems, became parts of larger ones, as for example the union of the separate peripheral members of the great Mississippi River system, which now forms a common drainage for the principal part of the continent. The Ohio and Upper Mississippi, the two most ancient portions of the present great system, were once separate rivers emptying into a northern extension of the Great Gulf, and it is practically certain that neither of them receive that portion of the molluscan fauna which now so strongly characterizes them until after the confluence with them of the western portions of the present great river system, which brought the fauna from its ancient home in the western part of the continent." Dr. White then adds in a footnote: "These remarks are made with especial reference to the Unionidæ, but they are also applicable to other gill-bearing mollusca, and they will no doubt apply with equal force to at least a part of the ichthyic fauna of that great river system. The progenitors of the ganoids, now living in that river system, were undoubtedly landlocked in the Laramie sea, continued through the fresh-water Eocene lakes, and finally escaped to the present river system in the manner already suggested."

Wilder and Gage's Anatomical Technology as applied to the domestic Cat.[1]—The authors' evident purpose in preparing this work has been to acquaint the beginner in anatomy with the instruments and other material necessary for use in dissecting, the methods of dissecting, and finally a full description of the most important parts of the cat, including the skeleton, the muscles of the shoulder and arm, the more important viscera, the vascular system, the nervous system in general, but especially the brain. It is apparently not intended to be a contribution to the general and comparative anatomy of the cat, as it is not exhaustive of the anatomy of a single cat. Hence it would not be fair to compare it with Mivart's excellent work on the cat in all its relations, anatomical, morphological, psychological, biological, and palæontological. The work is for use in the dissecting room, to be handled and conned over with scalpel and forceps in hand. As such it seems to us to be very well adapted to its purpose, but for this reason a good deal of matter which appears in the early part of the book seems to us, as will be seen further on, to be somewhat in the student's way and out of place. The introduction is a singular *melange*, five pages being devoted to an excursus on the metric system. Under the head of terminology are several pages of irrelevant and whimsical matter, including correspondence and quotations, with seven pages wasted on "The slip system of notes," which seem to us quite out of place. The introduction exhibits a singular lack of perspective; it ends with a page and a half of aphorisms, a strange jumble of anatomical proverbs, which the author has picked up from authors of all grades, from Joseph Henry and Owen to Philip G. Hamerton. This introduction, if boiled down and digested into a plain succinct explanation of terms to be used in the body of the work, would have been much more convenient to the beginner.

The authors have attempted a reform in terminology, and a reform is needed. Thirty-four pages are devoted to a discussion of this reform, but a good deal of the matter, it seems to us, might have been omitted in the present book; the discussion is too rambling for a laboratory guide-book, yet the suggestions are in some cases excellent. The terms *meson* and *mesal*, *ectad* and *entad*, *dorsad* and *ventrad*, and the compounds on p. 32 are useful adverbs, but we should hesitate before using the terms *dorsiduct*, *dorsicumbent*, *latericumbent*, *cephaloduct*, *dextriflexion*, or *sinistriflexion*, or even *caudiduct*. On the rare occasions when a grown-up man has occasion to pull a cat's tail, we should say so in so many Saxon words. The term transection for transverse section, and hemisection for longitudinal section, are good innovations.

[1] *Anatomical Technology as applied to the domestic Cat.* An introduction to human, veterinary, and comparative anatomy, with illustrations. By Burt G. Wilder and Simon H. Gage. New York and Chicago, 1882, A. S. Barnes & Co. 8vo, pp. 375.

We then come to the anatomical *technique*, or technology, to which ninety pages are devoted. The instructions, descriptions of instruments and apparatus are minute and exhaustive, ranging from a description of injecting syringes and anæsthetic box down to that of the waste pail, the bottle brush, and killing fleas. The descriptions are indeed so circumstantial that a fool may not err therein. On p. 79 we are told how cats may be caught, and a cat net and bag attached like a net to a hoop and pole, are suggested when the cat can't be inveigled by moral or manual suasion.

Chapter second begins with a general description of the skeleton, when the authors suddenly break off to discuss abdominal landmarks and abdominal and thoracic transection, and then follows a long chapter (the third) on the preparation of bones, and the details of preparation and arrangement of anatomical specimens in the museum. The student is finally, in chapter fifth, brought back to the study of the skeleton bones.

The directions for dissecting the muscles, viscera and nervous systems, and their description, are clear and sufficiently circumstantial. A good deal of space is given to the brain. An appendix contains valuable hints, mostly relating to anatomical technology, including the method of pithing a frog.

The illustrations are an important feature of the book. They are usually well, though not elegantly, drawn, and the several bones, muscles, and viscera are distinctly lettered, though the lettering is rather clumsy.

By leaving out certain portions (including the three sets of aphorisms), some twenty or thirty pages might have been saved, and the cat's hindquarters and other parts described, and the two sets of limbs compared, to the student's advantage.

While it must seem to the beginner, who has this book before him, a very formidable and solemn matter to dissect a cat, yet the work has been so conscientiously prepared that it will be very useful to the teacher as well as the student, and now that Tulk and Henfrey's Anatomical Manipulation (a work, by the way, not mentioned by the authors) is out of print, this is the only handbook of the kind in the language.

Recent Books and Pamphlets.

Stearns, Winfrid A., edited by Coues, Elliott.—New England Bird Life, being a manual of New England Ornithology. Part II. Non-oscine Passeres, birds of prey, game and water Birds. Boston, Lee & Shepard, 1883. From the author.

Gaudry, Albert.—Les enchainement du Monde Animal dans les temps géologiques. Fossiles primaires. Paris; Librarie F. Savy, 1883. From the author.

Frazer, Persifor.—Notes from the literature on the Geology of Egypt, and examination of the syenitic granite of the obelisk which Lieut.-Commander Gorringe, U.S.N., brought to New York. Ext. Trans. Amer. Inst. Ming. Eng. 1883. From the author.

——The iron ores of the Middle James river. Ext. idem. read 1881. From the author.

Hill, Albert C.—Management of structural steel. Ext. Trans. Amer. Inst. Ming. Eng. 1883. From the author.

Magnus, Troilus.—The analysis of furnace gases. The determination of copper in steel. Ext. idem. 1883. From the author.

Schaeffer, Chas. A.—On the occurrence of gold in Williamson county, Texas. Ext. idem. 1883. From the author.

Williams, Albert, Jr.—Note on settling tanks in silver mills. Ext. idem. 1883. From the author.

Stone, G. C.—The determination of manganese in spiegel. Ext. idem. 1883. From the author.

Sharples, S. P.—Experiments on American woods. Ext. idem. 1883. From the author.

Richards, R. H.—A new hydraulic separator to prepare ores for jigging and table work. Ext. idem. 1883. From the author.

Hunt, T. Sterry.—Coal and iron in Alabama. Ext. idem. 1883. From the author.

Blandy, J. F.—The mining region round Prescott, Arizona. Ext. idem. 1883. From the author.

Bowron, W. M.—The practical metallurgy of Titaniferous ores. Ext. idem. 1883. From the author.

Bayles, J. C.—Microscopic analysis of the structures of iron and steel. Ext. idem. 1883. From the author.

Goodyear, W. A.—Water-gas as fuel. Ext. idem. 1833. From the author.

Gigiioli, E. Hillyer.—La Scoperta di una Fauna Abissale nel Mediteraneo. Roma. 1883. From the author.

Cope, E. D.—Palæontological Bulletin, No. 36. First addition to the fauna of the Puerco Eocene. On the brains of the Eocene Mammalia Phenacodus and Periptychus. Fourth Contribution to the history of the Permian Formation of Texas. Ext. Proc. Amer. Philos. Soc. 1883. From the author.

——On the mutual relations of the Bunotherian Mammalia. Ext. Proc. Ac. Nat. Sci. Phil. 1883. From the author.

Bouchon-Brandely.—Report relative to the generation and artificial fecundation of Oysters, addressed to the Minister of Marine and the Colonies. Ex. idem. Ext. Bull. U. S. Fish Commission. Translated, with notes, by J. A. Ryder.

——On the sexuality of the common Oyster and that of the Portuguese Oyster. Artificial fecundation of the Portuguese Oyster. Translated by J. A. Ryder. 1883. From the translator.

Jordan, D. S., and Henshaw, H. W.—Report upon the Fishes collected during 1875, '76 and '77, in California and Nevada. Ext. Rep. Chief of Engineers. Geog. Surv. W. of the 100th meridian. 1883. From the authors.

Yarrow, H. C., and Henshaw, H. W.—Report upon the Reptiles and Batrachians collected during 1875, '76 and '77, in California, Arizona and Nevada. Ext. idem. 1883. From the authors,

Potts, Edward F.—Fresh-water Sponges. What, Where, When and Who wants them. From the author.

Lawrence, G. N.—Description of new sub-species of Loxigilla from St. Christopher, W. I.

——Description of a new species of bird of the family Turdidæ from Dominica, W. I.

——Description of a new species of Icterus from the West Indies. All from Proc. U. S. Nat. Mus., 1880.

——Description of a new species of the family Cypselidæ.

——Description of two new species of birds from Yucatan.

——Description of a new Chætura. All from Annals N. Y. Acad. Sci. From the author.

Editor Sanitary Engineer.—President Chandler and the N. Y. City Health Dept. Rep. Sany. Eng., May, 1883.

Hector, J.—Seventeenth annual report on the Colonial Museum and Laboratory. Wellington, N. Z., 1883. From the author.

Gilbert, G. K.—Contributions to the history of Lake Bonneville. Ext. Ann. Rep. Director U. S. Geol. Survey, 1880–81. From the author.

Lemoine, Victor.—Recherches sur les Oiseaux Fossiles des Terrains Tertiares Inférieurs des environs de Reims. Deuxieme Partie. Reims, 1881. From the author.

Wood, J. R.—A paradise for Gunners and Anglers.

Fischer, J. G.—Beschreibungen neuer Reptilien. Hamburg, 1883. From the author.

Hale, Horatio.—Indian migrations as evidenced by language. Amer. Antiquarian 1883. From the author.

Hicks, L. E.—A critique of design-arguments. Chas. Scribner's Sons, N. Y., 1883. From the author.

Parker, W. K.—On the development of the skull in *Lepidosteus osseus.* Ext. Philos. Trans. Roy. Soc. London, 1882.

——On the structure and development of the skull in Sturgeons. Ext. idem. Both from the author.

Holder, J. B.—The Atlantic right Whales. Ext. Bull. Amer. Mus. Nat. Hist., N. Y. 1883. From the author.

Lemoine, ——Sur l'encephale de l'Arctocyon Dueilii et du Pleuraspidotherium Aumonieri, Mammifères de l'eocène inférieur des environs de Reims.

——Sur deux Plagiaulax tertiaires, recueillis aux environs de Reims. From the Comptes Rendus, Nov., 1881. From the author.

Walker, F. A. and Seaton, C. W.—Compendium of the tenth census, June 1, 1880. Parts I and II. Washington, 1883. From the department.

McCosh, J.—Development. What it can do, and What it cannot do. N. Y., 1883. From the author.

Flower, W. H.—On the Whales of the genus Hyperoodon. Ext. Proc. Zool. Soc. London, 1882. From the author.

Crane, Agnes.—The New Southern railroad to Colorado and California. Leisure Hour, London, 1883. From the author.

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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

The Arctic Regions.—The record of the winter spent upon the inhospitable shores of Franz Josef Land in 80° N. lat., by the shipwrecked crew of the *Eira*, shows what can be done when proper subordination is maintained. The *Eira* left Peterhead on July 14, 1881, reached Franz Josef Land July 23d, and on August 21st was caught between the pack ice and land floe, sprung a leak, and went down in eleven fathoms, giving time, however, to save a stock of provisions, etc. The shipwrecked crew at once built a hut of turf and stones, and set to work to collect driftwood, and shoot bears, walrus, and "looms." In September a storehouse that had been previously built on Bell island was visited, and its contents brought to the hut on Cape Flora. The preserved meat and soups were saved for the boat voyage, but each man was served daily with two-fifths of a pound of preserved vegetables, one-fourth pound of flour, and some tea and rum from the stores. Fortunately the quantity of fresh meat obtained was

[1] This department is edited by W. N. Lockington, Philadelphia.

so large that each man received one and two-fifths pounds, or even more daily. The wood and coal were consumed by January 8th, and from that time the only fuel was blubber. Thanks to the fresh meat, there was no sign of scurvy. On June 21st the return boat voyage was commenced, and was bravely continued, with alternations of hauling across ice, until on August 2d the coast of Novaya Zemlya was reached. There the *Hope*, sent out to search for the *Eira*, was met with, also the *Kara* and the *Willem Barents* The experience of the *Eira*, as well as the previous one of the *Tegethoff*, prove that the winter on the southern side of Franz Josef Land is milder than that of the same latitude on Smith's Sound. In December the thermometer rose to $+31°$, with a mean for the month of $+4°$; in January and February the mean was $-26°$, and the lowest $-43°$.

The presence of open water ensures that of bears and walrus all the year round, and that of flocks of birds eight months out of twelve. No deer, hares, or ptarmigan were met with on this island either by the crew of the *Eira* or that of the *Tegethoff*. It appears to be proved that this region is a suitable base whence to push exploration towards the pole.

Cliffs of columnar basalt, about eight hundred feet high, were seen in Gray bay, also an old sea-beach ninety feet above the sea. All the bears shot during the winter were males, and the experience of Lieut. Payer was in this respect similar.

Baron Nordenskjöld's expedition to Greenland has for its objects the exploration of the interior, to ascertain the extent of the drift ice between Cape Farewell and Iceland, to study the fossils and the peculiar blocks of ironstone on the west coast, and also to penetrate northwards along the unknown east coast.

Baron Nordenskjöld believes that the interior of Greenland, like that of the large continents, is an enclosed valley, and that the winds having lost their moisture upon the bordering mountain ranges, must be dry and comparatively warm, as is the case in other parts of the world with winds descending from a snow-clad mountain, on the other slope of which they have lost their moisture.

The *Willem Barents* has left for the Arctic to endeavor to discover the Dutch expedition in the Varna.

It appears that there is now little doubt that the "Zeni Narrative," published in 1558 by Francesco Marcolini, is in the main authentic, and that civilized communities, the descendants of the early Scandinavian colonists, persisted in the far north up to the close of the fourteenth century. The most important map in use in the middle of the sixteenth century is a manuscript map discovered by Baron Nordenskjöld in a manuscript copy of Ptolemy's Cosmographia preserved in the town library of Nancy. This map was made by a native of the Danish island of Fyen, and its close correspondence with the Zeni map is obvious. East Greenland

and Northwest America are clearly shown on this pre-Columbian map.

Africa.—Mr. J. T. Last has visited the dreaded Masai at a spot about 120 miles from the coast at Pagani. He was tolerably well received, and obtained much information respecting their language, customs, and social condition. He describes them as a fine race, with high forehead, thin lips, and long, straight nose, though with short crisp hair, and nearly black complexion. The women are especially fine in height and build.

Pére Depelchin, of the Society of Jesus, has sent to the *Précis Historiques* a contribution respecting the tribes upon the Zambesi, near the confluence of the Chobe. The Barotse are the ruling tribe, and subject to them are the Ma-Nansa, the Ma-Laya, the Ma-Shubia, the Ma-Ntchoia, the Ma-Mbunda, the Ba-Libale, the Ma-Pingula, and the Ma-Hés. The Ma-Shukulombwe and the Ba-Tonga are independent. All these peoples, although possessing each a separate language, speak the language of their former rulers, the Ma-Kololo. This tongue, called Se-Kololo, is a compound dialect akin to the Se-Suto and Se-Chuana.

An African commission of the Lisbon Geographical Society has recently published a memorandum on the rights of Portugal upon the Congo. This document claims the Congo and the territories to the north of it as belonging to Portugal by discovery, possession, and recognition. The territory claimed extends from the Congo northwards to Molembo inclusively, with an opinion that it could be claimed much further northward. The interior boundary is stated to be undetermined, and to be dependent on the needs and future resolutions of the Portuguese administration and colonial policy, but capable of definition by future treaties with native chiefs, or by their submission to Portuguese authority. The point of discovery is well proved by reference to the voyages made in the fifteenth century, and the first colonizing expedition was sent out in 1491.

Dr. Oscar Lenz, in an address delivered before the Munich Geographical Society, maintained that the aridity of the Western Sahara, crossed by him between Morocco and Timbuctoo, is comparatively recent, and was caused by the felling of the forests on the Ahaggar Mountain range, thus drying up the springs of the river that flowed through the plains.

Few know that the so-called Queen of Madagascar is really only queen of the half of the island, that dominated by the Hova. This people formerly inhabited the centre of the island, and were tributary to the Malagasy, but with English aid in the first half of this century they not only freed themselves, but conquered their neighbors to the east as far as the coast. The Hova men look much like sunburnt whites, the women often possess a sensuous beauty. They are poor, and live in unfinished huts. In

character they are false. Lies are virtuous, the mother teaches her children falsehood. The Hovas have an hereditary nobility, a middle class of workmen and traders, and a slave class.

Herr Von Maeehow states that the heights that border the valley of the Kuango reach a height of eight hundred to a thousand feet, while the stream in sóme places is eight hundred to a thousand feet wide, in others reaches eighteen hundred paces. Everywhere were magnificent forests, and hippopotami were abundant.

News from Mr. Stanley, dating to the middle of December, states that he has started for Vivi, the first of seven stations established by the International African Society. At Vivi preparations are making for the construction of a railway line to the landing place on the river. Bolobo, the last station established, is seven hundred miles from the mouth of the Congo. The seven stations already seem to have become centres of civilization, and are making their influence felt upon the surrounding tribes. Cattle have been introduced at Vivi, cabbage and lettuce are thriving at Leopoldsville, and three small steamers are launched. Fears are entertained lest through the claims of the Portuguese government obstructions to the freedom of way and commerce may arise.

Several Swedish officers have recently left Europe to join Mr. Stanley.

GEOLOGY AND PALÆONTOLOGY.

THE STRUCTURE AND APPEARANCE OF A LARAMIE DINOSAURIAN.—During the expedition of 1882 Messrs. Wortman and Hill discovered in the Laramie formation of Dakota, the nearly entire skeleton of a gigantic herbivorous land-saurian. On investigation it proves to be the *Diclonius mirabilis* of Leidy. The genus Diclonius Cope, is one of the Hadrosauridæ, and differs from Hadrosaurus in the coössification of the astragalo-calcaneum with the tibia. The Hadrosauridæ present the characters of the suborder Orthopoda (Stegosauria and Ornithopoda Marsh). I give an account of the osteology of the skull, together with some systematic conclusions, in the Proceedings of the Philadelphia Academy for 1883, p. 97. The present notice recites a few of the points of that article.

According to Mr. Wortman the total length of the skeleton is thirty-eight feet. The skull measures 1.180 meters. The general form and appearance of the skull, as seen in profile, is a good deal like that of a goose. From above it has more the form of a rather short-billed spoonbill (Platalea). For a reptile the head is unusually elevated posteriorly, and remarkably contracted at the anterior part of the maxillaries. The flat, transverse expansion of the premaxillaries is absolutely unique. The posterior edges

of the occipital bones are produced far backwards, forming a thin roof over the anterior part of the vertebral column.

The orbit is posterior in position, and is a horizontal oblong in form. The superior (superciliary) border is flat, with slight rugosities at the positions of the pre- and postfrontal sutures. The frontal region is a little concave, and there is a convexity of the superior face of the prefrontal bone in front of the line of the orbit. The peculiar position of the teeth gives the side of the face, when the mandible is closed, a horizontally extended concavity.

The dentition is remarkable for its complexity, and for the difference in character presented by the superior and inferior series. Leidy pointed out the character of the latter[1] in the *Hadrosaurus foulkei*, and I have described the character of the superior dentition in the genera Cionodon[2] and Diclonius[3]

As compared with the *Hadrosaurus foulkei*, the dental magazine is much deeper, and contains a greater number of teeth in a vertical column, and probably a larger number in the aggregate. I find in each maxillary bone of the *Diclonius mirabilis*, six hundred and thirty teeth, and in each splenial bone, four hundred and six teeth. The total number is then two thousand and seventy-two.

The greater part of the external and inferior faces of the ramus of the lower jaw is formed by the surangular bone, which has an enormous extent, far exceeding in size that of any known reptile. It extends posteriorly to below the quadrate cotylus. Anteriorly it spreads laterally and unites with its fellow of the opposite side, forming a short symphysis and simulating a dentary. In correspondence with this extent of the surangular, the splenial is enormously developed, and contains the great magazine of teeth which I have described as characteristic of this type.[4] Its internal wall is very thin, and adheres closely to the faces of the teeth, in the fossil, in its present condition. This development and dentition of the splenial bone distinguishes the Hadrosauridæ widely from the Iguanodontidæ. The dentary bone is a flat, semicircular plate attached by a suture to the extremities of the surangulars. There is no trace of symphysial suture, and the posterior border sends a median prolongation backwards, which is embraced by the surangulars. The edge of the dentary is flat, thin and edentulous, and closes within the edge of the premaxillary.

Dermal or corneous structures have left distinct traces in the soft sandstone about the end of the beak-like muzzle. Laminæ of brown remnants of organic structures were exposed in re-

[1] Cretaceous Reptiles North America, 1864, p. 83.

[2] Vertebrata of Cretaceous formations of the West, 1875, p. 59.

[3] Proceedings Philadelphia Academy, 1876, p. 250.

[4] Bulletin Geological Survey of the Territories. F. V. Hayden, III, pp. 594–7, May, 1877.

moving the matrix. One of these extends as a broad vertical band round the sides, indicating a vertical rim to the lower jaw, like that which surrounds some tea trays, and which probably represents the tomia of the horny sheath of a bird's beak. At the front of the muzzle its face is sharply undulate, presenting the appearance of vertical columns with tooth-like apices. Corresponding tooth-like processes, of much smaller size, alternate with them from the upper jaw. These probably are the remains of a serration of the extremital part on the horny tomia, such as exist on the lateral portions in the lamellirostral birds.

General affinities.—The structure of the skull of this species adds some confirmation to the hypothesis of the avian affinities of the Dinosauria, which I first announced, as indicated by the hind limbs, and which Professor Huxley soon after observed in the characters of the limbs and pelvis. The confirmation is, however, empirical rather than essential, and is confined to a few points. One of these is the form and position of the vomer, which much resembles that seen in lamellirostral birds. The large development of the premaxillary bone has a similar significance. So has the toothless character of that bone and the dentary.

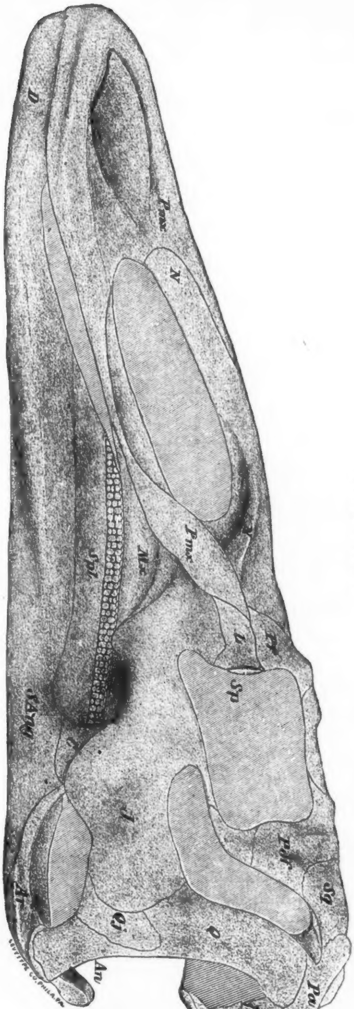
Among reptiles this skull combines, in an interesting way, the characters of the two orders Crocodilia and Lacertilia. The extension of the premaxillary above the maxillary, so far as to overlap the lachrymal, is unique among Vertebrata, so far as I am aware. The free exoccipito-intercalare hook is scarcely less remarkable.

Of mammalian affinity no trace can be found.

Restoration.—This animal in life presented the kangaroo-like proportions ascribed by Leidy to the *Hadrosaurus foulkei.* The anterior limbs are small, and were doubtless used occasionally for support, and rarely for prehension. This is to be supposed from the fact that the ungual phalanges of the manus are hoof-like, and not claw-like, though less ungulate in their character than those of the posterior foot. The inferior presentation of the occipital condyle shows that the head was borne on the summit of a vertical neck, and at right angles to it, in the manner of a bird. The head would be poised at right angles to the neck when the animal rested on the anterior feet by the aid of a U-like flexure of the cervical vertebræ. The general appearance of the head must have been much like that of a bird.

The nature of the beak and the dentition indicate, for this strange animal, a diet of soft vegetable matter. It could not have eaten the branches of trees, since any pressure sufficient for their comminution would have probably broken the slightly attached teeth of the lower jaw from their places, and have scattered them on the floor of the mouth. It is difficult to understand also how such a weak spatulate beak could have collected or have broken off boughs of trees. By the aid of its dentate horny edge it may

PLATE XVI.



Diclonius mirabilis, one-seventh nat. size.

NOTE ON DICLONIUS.—The plates of the skull of the *D. mirabilis*, issued with this number of the NATURALIST, should be bound with the preceding (July) number. The statement in the latter, "All the figures are of the natural size," is of course erroneous. The space for proportion of size was left to be filled, and was closed and printed inadvertently.

PLATE XVII.

Diclonius mirabilis, one seventh nat. size.

PLATE XIX.

Diclonius mirabilis, one-seventh nat. size; posterior and anterior extremities of skull.

have scraped leaves from the ends of branches, but the appearances indicate softer and less tenacious food. Could we suppose that the waters of the great Laramie lakes had supplied abundant aquatic plants without woody tissue, we would have the condition appropriate to this curious structure. Nymphæas, Nuphars, Potamogetons, Anacharis, Myriophyllum, and similar growths, could have been easily gathered by this double spoon-like bill, and have been tossed, by bird-like jerks of the head and neck, back to the mill of small and delicate teeth. In order to submit the food to the action of these vertical shears, the jaws must have been opened widely enough to permit their edges to clear each other, and a good deal of wide gaping must, therefore, have accompanied the act of mastication. This would be easy, as the mouth opens, as in reptiles and birds generally, to a point behind the line of the position of the eye. The eye was evidently of large size. The coronoid process of the mandible encroaches on the orbit below, and the temporal muscle evidently did so posteriorly. It is probable, as suggested to me by Mr. Geismar, that in the act of mastication the eye was alternately protruded and retracted with the contraction and extension of the temporal muscle. The indications are that the external ear was of very small size. There is a large tract that might have been devoted to the sense of smell, but whether it was so or not is not easily ascertained.

We can suppose that the long hind legs of this genus and of Hadrosaurus were especially useful in wading in the waters that produced their food. As Dollo has shown that the muscles of the fourth trochanter (third trochanter Auctorum) are attached to the proximal caudal vertebræ, one can see the huge tail swing from side to side with each advancing step, and create a great swirl in the water. When the bottom was not too soft, they could wade to a depth of ten or more feet, and, if necessary, drag aquatic plants from their hold below. Fishes might have been available as food when not too large, and not covered with bony scales. Most of the fishes of the Laramie period are, however, of the latter kind (genus Clastes). The occurrence of several beds of lignite in the formation shows that vegetation was abundant.

EXPLANATION OF PLATES.

(All are 1/7 ~~natural~~ size.)

PLATE XVI. Side view of the skull of *Diclonius mirabilis.*

" XVII. The same viewed from above.

" XVIII. Inferior view of the same.

" XIX, Fig. 1. View of occipital region of the same. Fig. 2. View of the extremity of the muzzle from the front.

The complete iconography of this species will appear in the Report of the United States Geological Survey, under J. W. Powell, now in course of preparation.

—*E. D. Cope.*

A NEW EDENTATE.—M. Burmeister describes, under the name of *Nothropus priscus*, a sloth from the pampas of the Argentine Republic. Megatherium, Scelidotherium, Mylodon, and other gigantic related forms did not climb trees, and were not nearly related to the existing Bradypodidæ, whereas Nothropus, though twice the size of the largest sloth now living, probably possessed their arboreal habits. Though half the lower jaw with three teeth is all that is known of this genus, the form of the bone and conformation of the teeth is unmistakable, but approaches Cholœpus more than Bradypus. The crown of the hinder molars has a tendency to divide into two lobes, thus recalling the molars of the huge extinct gravigrades.

GEOLOGICAL NEWS. — *Palæozoic.* — In the May issue of the *Geological Magazine*, Professor C. Lapworth commences a series of articles upon the stratigraphy of the highly convoluted lower Palæozoic rocks, with the object of showing that conclusions as to the relative age of the strata, based upon their apparent position, may often prove erroneous through the abrupt sigmoidal flexures that complicate their structure. After denudation has taken place, an older stratum of the upper part of the sigmaplex or sigmoidal fold may apparently rest unconformably upon a newer stratum.

Tertiary.—Baron von Ettingshausen contributes to the April issue of the *Geological Magazine* an article upon the Tertiary flora of Australia, including a list of about a hundred species. Twenty-seven species from Dalton, New South Wales, are all new, but only two of the twenty-one genera are new, the others occurring in the Tertiary of Europe (19), North America and North Asia (13), Java (4), Sumatra (3). Only six are contained in the living flora of Australia. Thus the Tertiary flora of Australia is far more nearly allied to the Tertiary floras of the other continents than to the living flora of Australia.——Mr. E. T. Newton has published the results of his investigations among the Vertebrata of the Forest Bed series of Norfolk and Suffolk. Exclusive of some unnamed Cervidæ, seventy-nine species are enumerated, including the mammoth. Three species are entirely new. These remains belong to the fauna of Great Britain in the period immediately antecedent to the Glacial epoch.

Quaternary.—The fauna and flora of the European loess are again brought to the front by Mr. Howorth in an answer (*Geol. Mag.*, May) to Dr. Nehring. Mr. Howorth maintains that the "steppe fauna" of the latter is rather an upland fauna, and that the grassy regions which, according to Dr. Nehring, existed and supplied pasturage for this fauna, could not possibly be the source of the accumulations of dust needed by Dr. Richthofen's theory of the origin of the loess.——The Philosophical Faculty of the University of Munich have awarded the prize offered for a "Thorough description of the Diluvial Glacial formations and

phenomena in the region of the South Bavarian high plateau, and also in the Bavarian Alps," to Dr. A. Penck, of the Munich University. The work treats of the last glaciation of Upper Bavaria and North Tyrol, of older glaciations in the same districts, and of the formation of the Upper Bavarian lakes. A complete description of the effects of ice action in the defined localities, is given, also a comparison with those of North Germany and Scandinavia, and the concluding chapter has an able discussion on the causes of the Glacial epoch.——At a recent meeting of the Geological Society of London, Mr. D. Mackintosh gave the results of observations on the positions of boulders relatively to the ground around and below them. His investigations were carried on near Llangollen (Wales) and at Clapham (Yorkshire) and his results are, that the average *vertical extent* of the denudation of limestone rock around boulders has not been more than six inches, and that this denudation has been at a rate of not less than an inch in a thousand years. This gives not more than 6000 years since the boulders were deposited.

Recent.—The Rev. A. Irving (*Geological Magazine*, April) gives the classification of landslips adopted by Herr Heini, of Zurich. These " Bergstürze " are either " Schuttrutschungen " or descents of water-logged accumulations from the mountain slope into the valley, a movement which sometimes produces striations simulating those of glacial action; " Schuttstürze," or emptyings upon the valley below of loose material, accumulated in a minor valley on the mountain side; Felsschlipfe," or loosenings of the upper strata, when the general dip is towards the valley, by the erosion of the lower part of the sides into a slope much deeper than the dip slope of the strata of the mountain above; and " Felsstürze," or the breaking loose from the sides of the mountain of huge masses of rock.

MINERALOGY.[1]

SCOVILLITE, A NEW MINERAL.—Professors G. J. Brush and S. L. Penfield have described[2] an interesting mineral from the Scoville ore bed in Salisbury, Conn., which occurs as an incrustation on certain iron and manganese ores. The incrustation, one-sixteenth of an inch or less in thickness is sometimes botryoidal or stalactitic in form and in cross fracture has a radiated, fibrous structure. It thus resembles in its mode of occurrence similar coatings of gibbsite. It has a pinkish, brownish, or yellowish-white color, a silky to vitreous lustre on the fracture, but has a greasy look on the natural surfaces, resembling some varieties of chalcedony or smithsonite. Hardness=3. 5. Specific gravity 3.94–4.01.

[1] Edited by Professor H. CARVILL LEWIS, Academy of Natural Sciences, Philadelphia, to whom communications, papers for review, etc., should be sent.

[2] *Amer. Journ. Sc. and Arts*, June, 1883.

Fused with salt of phosphorus and borax it gives a remarkable rose-colored bead in both flames. It is soluble in acid. The following mean composition was obtained:

P_2O_5	(Y_2O_3,Er_2O_3)	(La_2O_3,Di_2O_3)	Fe_2O_3	H_2O, (combined)	H_2O (lost at 100°)	CO_2	
24.94	8.51	55.17	.25	5.88	1.49	3.59	= 99.83.

Regarding the CO_2 as unessential and due to an admixture of lanthanite, the composition of the remaining mineral is calculated as follows:

P_2O_5	$(Y,Er_2)_2O_3$	$(La,Di)_2O_3$	Fe_2O_3	H_2O	
30 12	10.28	55.73	.30	3.57	= 100

The mineral is therefore a hydrous phosphate of the cerium and yttrium metals and is a new species. The mineral churchite approaches it most nearly in composition. The name Scovillite is proposed for it, after the locality where it was found.

THE ARTIFICIAL FORMATION OF MINERALS AND ROCKS.—Nearly all the interesting researches that have been made in forming minerals by artificial means are due to the chemists and mineralogists of France. Among these none are of more importance than those performed by Messrs. Fouqué and Michel-Lévy in the formation of various volcanic rocks and minerals through fusion. Recently they have collected their researches, heretofore scattered in several periodicals, in the form of an important volume entitled "Synthèse des mineraux et des roches." They employed platinum crucibles encased in fire clay and kept at a high heat for several days by means of a gas blast. By making use of the principle that minerals crystallize from the fluid magma in the inverse order of their fusibilty, and by keeping the melted minerals at different temperatures, carefully chosen, a number of artificial products closely resembling natural minerals and rocks were produced. Thus from a fused mixture of anorthite and augite, plagioclase crystals were obtained by a white heat, kept up for forty-eight hours, and on a second heating at a lower temperature augite crystals were formed, and the characteristic structure of an ophitic diabuse was obtained.

Most of the basic basaltic rocks were thus artificially formed by one or more fusions of a mixture of minerals. The acidic rocks, or those containing quartz, orthoclase, muscovite, hornblende, &c., could not thus be produced. An amorphous or glassy mass was obtained, and the latter minerals would not crystallize out of a fused mass.

The interesting conclusion is therefore reached that granite, gneiss, and other acidic rocks, with their enclosed minerals are not the result of igneous fusion. This is in accord with the generally accepted belief of geologists, derived from many considerations.

CONCRETIONS IN METEORITES.—Dr. J. L. Smith[1] describes a number of nodular or globular concretions which occur in metecrites, and states that the presence of such concretions is the general rule in meteoric iron.

The most common concretions are of troilite, a sulphide of iron. These have a dark bronze color and are numerous and often of large size. The troilite is often penetrated by a bright yellow mineral known as schreibersite, a phosphide of iron and nickle. Graphite also sometimes forms nodular concretions, and is commonly mixed with troilite. Daubreelite is another interesting mineral mixed with troilite, being a sulphide of iron and chromium. A concretion of chromite was found in one meteorite. The chromite was black, but a thin section under the microscope was of a deep red color. Lawrencite, a green protochloride of iron, and aragonite also occur in meteoric iron, the aragonite, however, being probably of secondary origin.

Dr. Smith thinks that the presence of these concretions indicates a former plasticity of the iron, caused by great heat.

MINERALOGICAL NOTES.—A new edition of E. S. Dana's Text book of Mineralogy has just been issued. The list of new minerals is brought up to date, and much important matter relating to the crystallographic and optical characters of minerals and to new instruments has been added.——A report on Virginia minerals by Mr. A. S. McCreath of Harrisburg, recently issued, contains numerous new analyses of ores, coals, &c., and will be of great value to practical men.——A variety of wad, to which the name *lepidophæite* has been given, occurs in Thuringia in fibrous or scaly masses, with silky lustre. It has a reddish brown color and soils the fingers when touched. It contains eleven per cent of oxide of copper.——Gonnard has described an occurrence of *gedrite* in the gneiss of Beauman, near Lyons. The mineral is in almond shaped masses, with lamellar or fibrous structure. The color is straw yellow to brown, and its characters are those of an anthophyllite containing alumina.——An *emerald* from Paavo, in Finland, analyzed by F. J. Wiik, was surrounded by a zone of radiated red albite, and this again by a yera of muscovite. ——*Wollastonite* has been obtained artificially by L. Bourgeois by melting together the required amounts of lime and silica at a bright red heat and cooling for two days in a furnace. A mass of acicular crystals was obtained, which, however, had optical properties unlike those of the natural mineral.——*Siderite* of a light green color occurs on hematite in the Lake Superior district, and is often associated with calcite. It is found either in crusts or in single crystals.

[1] *Amer. Journ. Sc.*, June, 1883.

BOTANY.[1]

NOTES ON THE STUDY OF FUNGI.—In view of the increasing interest in the study of mycology in this country some general remarks on this subject may not be out of place. In the first place, of course, here as elsewhere the question of *utility* comes up. The reply to this question given by Batarra, an Italian botanist of the eighteenth century, is still applicable. In his "Fungorum Agri Ariminenses Historia," published in 1755, in the chapter concerning the utility of Fungi, he says:

"Since everything placed on the earth by the wisdom of the Creator has been created through some wise design, and since all other productions contribute in some way to the uses of living beings on the earth, it cannot rationally be denied that Fungi also were intended to serve some good purpose, for the ideas of the unlearned crowd who regard these productions as of no account, and think that the tribe of Fungi might all be destroyed without causing any derangement in the economy of nature, and without detriment to the living beings on the earth, cannot be accepted by those who believe that God and nature made nothing in vain. We have to admit that the utility to be found in Fungi is not of the highest, yet this is not the fault of these productions themselves, but arises rather from the pride of men and their unwillingness to spend time and thought on those things which God in His wisdom was not ashamed to make.

"To specify more definitely then, in the first place, Fungi furnish an abundant supply of food to many tribes of insects" [a plea which will find no great favor with agriculturists, I suspect], "nor are they to be rejected as a means of sustenance for man. The mushroom, for example, and the morrel and various other kinds of esculent Fungi furnish an article of diet highly prized even on the tables of the rich."

Thus far Batarra's reasoning has lost none of its force up to the present time. But whatever opinion we may hold as to the absolute utility of Fungi themselves, it is certain that recent investigations into the habits and mode of growth of some of the parasitic species have enabled us to combat with more or less success their ravages on our cultivated crops, though it must be confessed that our knowledge is not yet accurate enough to enable us to control them with any great success. The "potato rot," the "grape rot," the "cranberry rot," and the various blights, molds and mildews with which we have to contend still remain to vex and plague us, and it certainly requires much faith and a strong imagination to believe that these pests, the parasitic Fungi, really serve any good purpose in the economy of nature. Throwing aside, however, the question of their utility as one which cannot yet in all cases be satisfactorily answered, we

[1] Edited by PROF. C. E. BESSEY, Ames, Iowa.

are safe in saying that the study of these minute organisms, presenting as they do such a vast variety of curious and beautiful forms, cannot fail to be of the deepest interest to the student of nature, and may yet lead to good results. To contribute then to this end and enlist perhaps new workers in the mycological field, it is proposed in some succeeding papers to notice briefly some of the microscopic Fungi, their habits and places of growth, and the way to find them out.

Among the earliest Fungi to appear in spring are the Aecidiums. These are little yellow cups, appearing on living or partly-dead leaves of various plants, generally on the under surface of the leaf, and mostly in groups or clusters on discolored and swollen spots or blotches, and are filled with the dust-like subglobose yellow spores. Generally the upper surface of the leaf directly opposite the clusters or cups below is also discolored, yellowish or reddish, and this discolored area, when examined with a lens, shows on its surface numerous minute slightly-projecting pustules, which are found, when examined with a microscope of higher power, to be filled with a multitude of minute granular spores, produced from the tips of numerous slender densely-crowded filaments, which arise from the inner surface of the cavity of the aforesaid pustules, which are technically called spermogonia from two Greek words signifying *spore generators.* Just what part these spermogonia play in the growth cycle of the fungus to which they belong is not yet certainly known. They are, however, intimately connected with the Aecidium, which again is now considered as only the first of three stages of growth of a polymorphic, or rather trimorphic fungus, of which the last and highest stage (teleutospores) is a Puccinia or Uromyces. In many species there comes in between these two another form called Uredo, of which the spores, very similar to those of the Aecidiums, are produced in subcuticular clusters not contained in cups as in Aecidium, but which, when the cuticle which at first covers them soon breaks away, are exposed on the surface of the leaf, which, from this cause, appears as if covered with little heaps of yellow, or reddish-yellow dust. The Aecidium and Uredo are oftener on the under surface of the leaf, but sometimes on both sides.

If now one wishes to *see* some of these curious productions of which so much has been written within the past few years, it is only necessary to provide an ordinary pocket lens, such as may be had at the opticians for twenty-five or fifty cents, and a tin box or pail with a tight-fitting cover, in which fresh leaves or flowers may be kept without wilting and brought home for further examination, and go out into the nearest field to see what can be found. At this date (May 21st) the leaves of the various species of Ranunculus may be examined for *Aecidium ranunculacearum*, which is now beginning to appear. The same species is also to

be found on *Anemone nemorosa* and Thalictrum. The affected leaves are easily recognized by the pale or faded spots on their upper surface, on which may be seen with the lens the minute spermogonial pustules, and on turning the leaf the cluster of cups, light colored and mealy outside and bright orange-yellow within, will at once be seen. Another form occurs on the *Ranunculus abortivus*, which was named by Schweinitz *Æcidium ranunculi*, but which he afterwards united with the first-mentioned species. It differs from the ordinary form in the cups being rather larger and less prominent, and perhaps of a deeper color inside, but more especially in having the cups quite evenly distributed over the lower face of the leaf, and not collected in clusters.

The leaves of the blue forget-me-not (*Houstonia cærulea*) also now begin to show a very beautiful little Æcidium (*A. houstoniatum* Schw.), of which the cups are much smaller than those of the species on Ranunculus, and more inclining to red inside. They are also more evenly scattered over the under surface of the leaves, which are scarcely discolored above. There is also now to be found on the leaves of the spring beauty (Claytonia) a very fine little Æcidium, which will be succeeded a little later by a Puccinia.

In June there will be found on the leaves of the common barberry bush (*Berberis vulgaris*) another Æcidium, which has been proved by actual experimental cultures to be only one stage of growth of the common wheat rust (*Puccinia graminis*). Among others, Dr. C. B. Plowright, of King's Lynn, England, has demonstrated this fact by a series of artificial cultures, the particulars of which he has published in the *Gardener's Chronicle* (1882). He finds that the spores of *Æcidium berberidis* placed on the leaves of a living wheat plant produce the common wheat rust (*Puccinia graminis*), the Uredo first, then the Puccinia, and that the Puccinia spores placed on the living leaves of the barberry produce *Æcidium berberidis*, and thus complete the circle. By similar experimental cultures it still remains to be shown to what particular Puccinia the various Æcidiums and Uredos belong, as the actual connection of many of them has not yet been shown, though it is probable that every Æcidium has its corresponding Puccinia.

But if none of the above-mentioned plants are to be found the common dandelion (*Taraxacum dens-leonis*) is to be met with almost everywhere, and affords a very fine little fungus. The leaves even to the naked eye will be seen to show on both surfaces little brown specks, which, when examined with the lens, appear like little heaps of brown dust, surrounded by the ruptured epidermis of the leaf. This dust is the spores of a Uredo, which is the forerunner of a Puccinia that will appear later in the season on the leaves of various composite plants, and has hence been called *Puccinia compositarum.* These Uredo spores, when

examined under a compound microscope, are found to be studded all over with fine projecting points, which give them a very neat appearance.—*J. B. Ellis, Newfield, N. J.*

Analysis of Vegetable Tissues.—Frémy classifies the constituents of vegetable tissues as follows, the characters being derived from their chemical constitution (*Ann. Sci. Nat.* xiii, 1882):

1. *Cellulose Substances.*—In this group are included all those constituents of vegetable tissues which dissolve without coloring in bi-hydrated sulphuric acid, producing dextrine and sugar; which are not sensibly altered by alkaline solvents, and which resist for a long time the action of energetic oxidizers. Schwitzer's reagent (ammoniacal copper oxide) enables at least the three following varieties to be distinguished:

(*a*) *Cellulose.*—Dissolves immediately in the copper reagent. This constitutes the larger part of cotton hairs and of the utricular tissues of certain fruits.

(*b*) *Paracellulose.*—Dissolves in the copper reagent only after the addition of an acid. This constitutes the utricular tissue of certain roots, and the epidermal cells of leaves.

(*c*) *Metacellulose.*—Insoluble in the copper reagent even after the addition of acids. It occurs principally in the tissue of fungi and lichens, and is the "fungine" of Braconnot.

2. *Vasculose.*—This is the substance which enters most largely into the composition of vessels and tracheids. It usually accompanies cellulose substances, but differs from them completely in composition and properties, containing more carbon and less hydrogen. It is the substance which in certain cases unites the cells and the fibers. It sometimes occurs on the exterior of tissues in the form of a continuous, resisting and horny membrane. It forms, in fact, the solid part of woody tissues; it is abundant in hard woods, and in the sclerenchymatous concretions in pears; the shells of nuts and the stones of stone-fruit often consist of this substance to more than half of their weight. Vasculose is insoluble in bi-hydrated sulphuric acid, and in the copper reagent; it does not dissolve sensibly at the ordinary pressure in alkaline solvents, but only with the assistance of pressure. This important property is utilized in the manufacture of paper from straw and wood. It dissolves rapidly in oxidizing substances, as chlorine water, hypochlorites, nitric acid, chromic acid, permanganates, etc. Before dissolving it, oxidizers change it into a resinous acid, soluble in alkalies. Cellulose substances can be removed from vasculose by the solvent action on them of bi-hydrated sulphuric acid, or Schweitzer's reagent. If, on the other hand, these substances have to be freed from vasculose, the tissue is subjected for several hours to the action of nitric acid diluted with its volume of water in the cold, which does not act sensibly on cellulose substances, while it transforms the vasculose into a yellow

resinous acid, which can then be dissolved out by means of an alkali.

3. *Cutose.*—This substance constitutes the fine transparent membrane which forms the surface of the ærial parts of plants; the "suberine" of Chevreul is a compound of cutose and vasculose. It possesses several characters in common with vasculose, resisting the action of bi-hydrated sulphuric acid, but it is soluble at the ordinary pressure in dilute or carbonated solutions of potassa and soda. It contains more carbon and hydrogen than vasculose. Subjected to the action of nitric acid it gives rise to suberic acid. To separate cutose from the cellulose substances, and from vasculose, the copper reagent is first used to dissolve the former, and the tissue is then agitated with potassa at the ordinary or at a higher pressure, the former dissolving the cutose, and the latter the vascular.

4. *Pectose.*—This substance is insoluble in water, but is dissolved by the action of dilute acids, and converted into pectine. It occurs ordinarily in the atricular tissues of roots and fruits, and is recognized by subjecting the tissue with heat to the action of dilute hydrochloric acid; it then forms pectine, which dissolves in the water, and can be precipitated by alcohol.

5. *Calcium pectate.*—This salt is often the basis of a tissue which occurs in the form of a continuous membrane, serving as in the pith of certain trees to bind the cells together. If this salt is decomposed by an acid, the tissue is immediately disintegrated into its constituent cells. Its determination is effected by heating the tissue in the cold with dilute hydrochloric acid, which decomposes the calcium pectate, leaving the pectic acid in an insoluble state; this is then heated with a dilute solution of potassa, producing a soluble pectate which can be again decomposed by acids.

6. The *Nitrogenous substances* contained in vegetable tissues are dissolved by alkalies.

7. The *Inorganic substances* constitute the ash after calcination.

In woods the proportion of vasculose increases with their hardness and density. The proportions of cellulose and paracellulose vary in stems; pine wood appears to be composed exclusively of paracellulose and vasculose. The parenchyma of the pith often contains considerable quantities of pectose and calcium pectate. Cork consists partly of "suberine," and is composed of cutose and vasculose. In leaves and petals the parenchyma consists of cellulose and pectose, the vascular bundles and vessels of vasculose and paracellulose. The utricular tissue of petals is composed almost entirely of cellulose, thin spiral vessels almost entirely of vasculose.

Vasculose can be obtained in special purity from the pith of the elder. After treating with dilute alkali it is boiled with dilute hydrochloric acid in order to transform the paracellulose into

cellulose; the ammoniacal copper reagent is then used, and the treatment repeated eight or ten times until no further reaction ensues. The pure vasculose thus obtained preserves a light yellow tint, maintaining the structure of the original tissue. The mean of several analyses of vasculose gives a composition corresponding to the formula, $C_{33}H_{23}O_{16}$.—*Jour. Royal Mic. Soc.* for April, 1883.

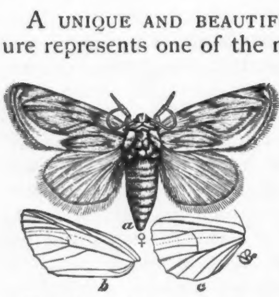
A CHINESE GYMNOCLADUS.—When Bentham & Hooker's first volume of the Genera Plantarum was written, the genus Gymnocladus was supposed to contain but one species, *G. canadensis*, the well-known "Kentucky coffee tree" of the Mississippi valley. Recently, according to the *Gardener's Chronicle*, a second species has been discovered in China, named by Baillon *G. chinensis*. From its description it appears to be much like our native species. Its leaflets are said to be more numerous, narrower, and not acuminate, and the pod is thick (3–4 inches long) and but slightly compressed. The shells, when steeped for a couple of days in water, yield a saponaceous substance which is used for washing. Do the pods of our species contain this property?

BOTANICAL NOTES.—*Puccinia buxi*, the box rust, is figured by W. G. Smith, in a recent number of the *Gardeners' Chronicle*.——Joseph Schrenk, in the April *Torrey Bulletin*, gives details of the structure of the haustoria of *Comandra umbellata*, accompanied by three plates. He shows that in this case "there exists a direct and unobstructed communication between the cells of the haustorium and those of its foster root."——In the same number, E. L. Greene describes five new species of Western plants, Dr. Vasey two new Western grasses, and Professor Tuckerman a new California lichen (*Ramalina crinita*).——A new Phallus (*P. togatus*) from Eastern Pennsylvania is described and figured in the May *Botanical Gazette*.——S. E. Cassino & Co., of Boston, announce that the manuscript of the long-promised Manual of North American Mosses, by Lesquereux and James, is completed, and in the printers' hands. It will be uniform with Gray's Manual, and will contain copper-plate illustrations. It is to be issued in the autumn.——M. E. Jones, the well-known botanical collector of Salt Lake City, Utah, has issued a thirty page pamphlet, descriptive of the ferns of the West. A few pages are given to general structure, after which follow specific descriptions of the genera and species which occur in the region from Nebraska westward. Altogether 108 species are described of which seven are Ophioglossaceæ, the remainder being true ferns (Filices).——Recent numbers of the *Botanische Zeitung* contain a valuable paper (with a plate) on cell division in Closterium.——J. G. Lemmon has issued a pamphlet of twenty-three pages on the discovery of the potato in Arizona, being the substance of a paper read before the California Academy of Sciences January 15, 1883.

——Professor Sorokine, of the University of Kazan, Russia, has begun the publication of a mongraph of the Chytridiaceæ, in the *Archives Botanique du Nord de la France.* It promises to be of great value. Each species is illustrated by wood cuts in the text.

ENTOMOLOGY.[1]

A UNIQUE AND BEAUTIFUL NOCTUID.—The accompanying figure represents one of the most striking and unique of our N. A. Noctuids in respect of color and pterogostic design, the general color being of a bright golden-yellow, and the lines and shades of a deeper gold, inclining to ferruginous or even ochreous.



Cirrophanus triangulifer Grt. *a*, male; *b*, *c*, venation of front and hind wings (after Riley).

Many years ago we had in our collection a single male specimen of this moth which was captured in August on hickory at Kirkwood, Mo. In 1871 we submitted it to a number of lepidopterists both in this country and in Europe, when, finding that it was unknown and could not well be referred to any defined genus, we gave it a MS. name, hoping some day to obtain the female. In the summer of 1872 Mr. A. R. Grote visited St. Louis during our absence, and was courteously granted permission by an assistant to go over our collection. He made various notes thereon, and among others took a hasty description of this unique moth. This description was at once published in the *Canadian Entomologist* (IV, Oct., 1872, p. 187) under the name of *Cirrhophanus triangulifer*, nov. gen. et sp., and, like all generic descriptions dashed off under such conditions, and without real study, was quite imperfect, all important structural details being omitted, and some of the characters given belonging to the male only. The description was accompanied by a statement of forgetfulness as to the source of the type, which, considering the fact that we were pretty well known to Mr. Grote at the time, and that our collection was the only general collection of insects in St. Louis, may be taken, perhaps, as illustrative of the effects of the " new infidelity " which he has preached.

The moth was redescribed in June, 1875, by Mr. H. K. Morrison as *Chariclea pretiosa* (Proc. Bost. Soc. Nat. Hist. XVIII, p. 122), while Mr. Grote amplified his own description in October of the same year (Proc. Ac. Nat. Sc. Phil. 1875, p. 421). It is, however, to the affinities of the species that we wish to direct attention. Grote at first allied it with Gortyna, leaving a wide

[1] This department is edited by Professor C. V. RILEY, Washington, D. C., to whom communications, books for notice, etc. should be sent.

margin, however, by making it resemble Halesidota (Bombycidæ) in size and outline, his opinion being necessarily superficial. In his Check List, published in 1875, he places it near Nonagria and Scoleocampa (Nonagriinæ), while in his new List (1882) it is referred to Chariclea (Kirby), and placed near Pyrrhia (Heliothinæ). In the Brooklyn list the former position is retained. In our opinion its affinities are clearly with the Pulsiinæ and Stiriinæ, and more remotely with the Heliothinæ. It plainly shows its relations with Basilodes and Stiria, both in coloration, markings, thoracic vestiture, frontal protuberance, compressed and exsertile ovipositor, wing-venation and tibial armature, the form of wing having less classificatory importance. It might therefore, with propriety, be placed in the Stiriinæ, a sub-family which has not been very clearly defined, and in which Mr. Grote would bring together several striking and aberrant forms.[1] The small and interesting *Xanthothrix neumögenii* H. Edw., has not only a suggestive resemblance in color and marking, but real relationship in the character of the frontal protruberance, tibial claw and exsertile ovipositor. Nonagria has a quite different frontal projection, while *Chariclea*[2] Kirby, as defined by Lederer, has different clypeal and thoracic characteristics, and a stronger tongue, the European *delphinii* being the only species having the front tibial claw.[3] Since the capture of our first male we have obtained other specimens from Missouri and Kansas, among them two females, and the following generic characters will assist lepidopterists in properly placing it:

Form robust. Head small; antennæ with the basal joint scaled; eyes naked, full, globose; palpi short and slender with joints 1 and 2 subequal in length; 3 one-third as long as 2; tongue feeble; clypeus (♀) with a central transversely oval projection ending in a brown corneous mouth or excavation, the lips being sharp, arched dorsally, straight ventrally where a cylindrical, black tubercle projects yet somewhat further; an inferior, curved, sharp, clypeal carina; in the ♂ the protruberance, its excavation and the emargination are feebler. Thorax tufted with hairs and scales somewhat as in Stiria; the principal tufts being a broad pair behind collar, a longer and erect pair between patagia which are also raised, thick and tuft-like; front tibiæ with a single, superior, terminal claw extending rather more than half their length in ♀. less pronounced in ♂; primaries broad, with apices well rounded, but with some variation in this respect; Venation as in Stiria, *i. e.* normal. Ovipositor horny compressed from sides, simple and exsertile.[4]

Structure is a very safe guide to habit, and we may conclude that the Stiriinæ with their horny, exsertile and specialized ovi-

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[1] *Papilio*, III, p 32.

[2] We know nothing of *Chariclea* Stephens whom Staudinger gives as authority for the genus.

[3] Mr. Smith has well characterized Chariclea in his recent Synopsis of the Heliothinæ referred to last month.

[4] Since this was written Mr. Grote has published his latest views on the Stiriinæ (*Can. Ent.* XV, pp. 72–77), justifying our views as above expressed, by reëstablishing Cirrhophanus, and placing it in the Stiriinæ. He defines Cirrhophanus for the fourth time, but still inaccuratety by omitting the front tibial claw, and the exsertile ovipositor. The ovipositor may not always be exserted, but it is, as in Basilodes, Stiria, and Stibadium exsertile, and often remains exserted in the dried specimen.

positors are endophytes—a conclusion strengthened by their tendency to grease, and explaining perhaps our ignorance thus far of their larvæ. There would also seem to be some correlation between this puncturing and thrusting ovipositor and the produced and specialized clypeus, and perhaps also with the large claw on front tibiæ; for these characters are most pronounced in the female, and doubtless bear upon habit.—*C. V. Riley.*

INSECTS AFFECTING STORED RICE.—In a lot of damaged rice from the Chinese Centennial exhibit recently submitted to us by the director of the National Museum, we found the following insects: Numerous larvæ of *Tenebrio molitor;* larvæ of *Tenebrio obscurus*, somewhat less numerous than the former; also a few imagos of the same species; numerous larvæ, pupæ and imagos of *Murmidius ovalis;* several larvæ and imagos of *Trogosita mauritanica;* numerous dead specimens of *Calandra oryzæ;* a few specimens of *Silvanus surinamensis;* a few larvæ of *Attagenus megatoma;* numerous larvæ of what appears to be *Ephestia zeæ;* a few specimens of *Lepisma saccharina*. The larvæ of *Trogosita mauritanica* are known to prey upon other soft-bodied insects, while those of *Attagenus megatoma* live also chiefly upon dried animal matter. The remaining species found in the rice are known to feed upon stored produce, and are of no special interest except the *Murmidius ovalis*, which is not often found in large numbers, and whose earlier states have hitherto remained unknown.

HYPERMETAMORPHOSES OF THE MELOIDÆ.—In treating of the transformations of the blister-beetles (*vide* AM. NAT., XII, p. 286, *ff*) we endeavored to conform to the existing nomenclature in characterizing the different forms which the larva presents, and employed the following terms:

1st larva	*Triungulin* (from the egg).
2d larva	*Carabidoid* stage (after first molt). *Scarabæidoid* stage (after second molt). *Ultimate* stage (after third molt).
	Coarctate larva (after fourth molt).
3d larva	*Third* larva (after fifth molt).

We are satisfied that this attempt to combine the more recent facts with previous views tends to confuse, and that the nomenclature may be simplified and made more consonant with the facts. We would propose, therefore, the following arrangement:

Triungulin	=	first larval stage.
Caraboid	=	second larval stage.
Scarabæoid	=	third and fourth larval stages.
Coarctate	=	fifth larval stage.
Scolytoid	=	sixth larval stage.

This nomenclature fully represents the facts, there being five distinct forms of larva, the difference in the third and fourth stages

being but slight and not suggesting any other than a scarabæoid larva. These five forms of larva will be found in all Meloïds so far traced in their earlier states, whether exuviation is but partial and imperfect as in Sitaris, Meloë, Hornia, etc., or whether it is more perfect as in Epicauta, Macrobasis, etc.—*C. V. Riley.*

COLOR PREFERENCES IN NOCTURNAL LEPIDOPTERA.—For two seasons past (1881 and 1882) I have made fruitless attempts to reach some definite conclusions as to the relative importance of a few primary colors as attracting signals to night-flying insects. I do not know whether the plan adopted is original or not, and as it may yield some useful or interesting results in the hands of others I briefly describe it. I made four or five sleeves, or cylinders open at both ends, of variously colored tissue papers, and drew them over common kerosene lamps with glass chimneys, the familiar illuminating agent of all country homes, thus improvising a very serviceable and inexpensive Chinese lantern. The advantage of this arrangement consists in the ease with which the colored sleeves can be changed, any combination of colors being secured without removing the lights, and so a uniformity of light power maintained at the several stations and for the several colors during one experiment. The method also permits a very easy adjustment of lights in their intensity, by raising or lowering the wicks, and thus allows the observer to test strength of mere illumination against attractiveness of color as a hue for the insects. The planting of the lights seems important. I started by placing them in a row at long distances from each other. The defect of this arrangement appeared to be that the brilliancy of the first light, encountered by the insects coming upon it from its side or portion of the row, interfered with the visitor's freedom of choice as between that color and another when the light from the others reached it in a dim and imperfect manner. The lanterns were then arranged in a square (four colors) whose dimensions were determined by the intensity of the several lights. The distance between the lanterns was such as to allow the limital circle of illumination of each at first to touch, and subsequently to intersect those of its neighbors. This distance was reduced until the separation between the lanterns was less than the radius of the circles of light which each threw around itself, the lights being of equal intensity. This proved unsatisfactory, and having devised no means of exhibiting a number of colored lights so that the chances were equalized completely for insects coming from all sides, to choose according to any constitutional preference for one color over another I used only two colors at a time. The arrangement might be found useful to place four lanterns in two pairs, each pair of one color, and in a diamond pattern so that each color appears equally prominent, no matter from what side the dazzled insect may approach the group. The apparent necessity for allowing the insect

to choose instantly between the colors before it reaches either arises from the infatuation produced in the insects by the light, which once reached seems to obliterate all capability in the creature to free itself from its enticement, except in an irregular and accidental manner. My experiments proved nothing except the absence of any marked preferences for certain colors over others, and the almost invariably greater charm exerted by the white lantern, which, on account of their translucency, appeared more brilliant than the colored lamps.—*L. P. Gratacap, New York.*

Entomological Notes.—The British "Council of Education" has established a committee of economic entomology, and among other able members appointed are Professor Huxley, Professor Westwood, Professor Wrightson (president of Downton College of Agriculture), Professor Dyer (sub-director Kew Gardens), and Miss Ormerod.——Dr. R. P. Hoy has published a list of the cold-blooded vertebrates and Lepidoptera of Wisconsin. The Micros are not included in the latter, but the Macros are very well represented, and forty-seven species of Catocala are recorded as taken within two miles of Racine.——Professor C. H. Fernald informs us that he has secured the collection of Pterophoridæ of Mr. Charles Fish, who has been obliged to abandon their study, and that he has also secured all of Fitch's material in the same family. We always experience a profound pleasure when a careful, conscientious and competent student takes hold of any given family with a view of eventually monographing or synopsizing it.——The report of the Entomological Society of Ontario, for the year 1882, is just at hand. The society is in a flourishing condition, and we are glad to learn that there is to be a general index to all the previous reports. There is a want of system in the matter of these reports resulting in much repetition of matter, while the use of the same cuts year after year becomes somewhat tedious.——Mr. George D. Hulst has an article on some Sesiidæ in the May number of the Bull, Brooklyn Ent. Soc. (Vol. VI, pp. 8–10), giving accounts of *Bembecia marginata*, *Sesia acerni*, and *Mellitia cucurbitæ*,—three species of economic interest. He falls into a singular error in quoting from our Sixth Mo. Ent. Rep. the account of the oviposition of *Oberea perspicillata*, and mistaking it for that of the Bembecia, which, as he shows, oviposits on the leaf. He found that the eggs fell with the leaves to the ground, and did not hatch before winter. Experience in the latitude of St. Louis indicates on the contrary that they do hatch in the fall, as stated in our report above cited, though doubtless there is variation in this respect.——In a synopsis of the genus Limenitis (*ibid.*, pp. 5–7) Mr. J. B. Smith recognizes but four species, *misippus*, *ursula*, *weidemeyerii*, and *lorquini*, sinking some ten of the late finely-split species of Edwards (W. H.) and Strecker, as varieties. In this we think he has done wisely, though many will question whether *arthemis* Drury, which is made a variety of

ursula, should not be considered a sufficiently good species.——The entomological papers from the transactions of the Iowa State Horticultural Society, for the year 1882, have been published separately for gratuitous circulation, and contain much information of practical value from Hon. J. N. Dixon, Miss Alice B. Walton, and Professor Herbert Osborn.——The monthly meetings of the Brooklyn Entomological Society will hereafter be held on the last Saturday of each month in Wright's business college, corner of Broadway and Fourth Streets.——The Stettiner Entomologische Zeitung, Vol. 44, 1883, Nos. 7–9, contains beside others of less general interest the following papers: Dr. H. A. Hagen's contributions to a monograph of the Psocidæ (continued); Remarks upon the influence of change of food upon morphological varieties, especially in the species of the genus Eupithecia, by Dr. A. Speyer; H. B. Möschler's notice of Fernald's catalogue of N. A. Tortricidae; and Dr. C. A. Dohrn's list of Zeller's entomological papers, published after the appearance of Hagen's Bibliotheca.——At the fiftieth anniversary meeting of the London Entomological Society, held May 2d of this year, Professor J. O. Westwood was elected by acclamation titular life-president of the society.

ZOÖLOGY.

THE SEA PENS OR PENNATULIDA.[1]—Professor Milnes Marshall and Mr. W. P. Marshall give an important and interesting account of the Pennatulida collected in the Oban Dredging Excursion of the Birmingham Natural History and Microscopical Society. *Funiculina quadrangularis*, *Pennatula phosphorea* and *Virgularia mirabilis* were the three forms collected.

The very primitive nature of the first of these is indicated by the irregular arrangement of the polyps, their independent insertion into the rachis, and in the comparatively slight difference between the polyps and the zoöids, as well as by the shortness of the stalk, or part of the colony devoid of polyps. In Pennatula we have the polyps fused into leaves, and there is a considerable difference in the size of their constituent parts, as well as great anatomical differences between the polyps and the zoöids; the stalk is also relatively much longer.

Virgularia is shown to be the most modified by the restriction of the reproductive organs to imperfectly developed polyps, and, in addition to these points, by the presence of the so-called radial vessels which are absent from the other two forms.

A very curious discovery has been made with regard to Virgularia; with but one exception all the known specimens of Virgularia are mutilated, the lower end being generally, and the upper always wanting; as a hypothesis, the author some time ago suggested that the tips were probably bitten off by some marine ani-

[1] 8vo, Birmingham, 1883, pp. 81 (4 pls.).

mals, probably fish. Since then they have (through Mr. R. D. Derbyshire) been able to examine the contents of a stomach of a haddock, which consisted of five fragments of *V. mirabilis*, and of these, three were "actual perfect upper ends;" as a possible explanation of this mutilation it is suggested that the apparent absence of stinging-cells from this species is not only apparent but real, so that the fish are enabled to bite at them with impunity. As the specimens examined were not in a thoroughly satisfactory condition for histological study, the question must be examined again with more satisfactory specimens.

The evidence afforded by the dredging leads to the supposition already suggested by Richiardi and Kölliker, that *Funiculina forbesi*, the supposed British species, is only the immature form of *F. quadrangularis*, which is well known from the Mediterranean. The most complete example from Oban is only thirty-nine inches long, but at Hamburg there is a stem eighty-nine inches in length.

The foregoing notice has been taken from the Journal of the Royal Microscopical Society. Having received from the authors a copy of the book, we can bear testimony to the excellence of the plates. The authors quote Dalyell's statement that Virgularia when in captivity "remains contracted during the greater part of the day, and the organs are seldom displayed before five or six in the afternoon;" but the authors with more reason suggest that Pennatula appears to be "nocturnal" when brought to the surface, "simply because the amount of light it receives in broad daylight is vastly in excess of what it receives normally at the sea bottom, and that it is only towards evening that it is placed under what to it are normal conditions as to amount of light."

The authors are strongly in favor of the now generally accepted view that Pennatula lives upright, planted in the sea bottom.

As regards the phosphorescence observed in the majority of the Pennatulida, *P. phosphorea* receiving its name from having this property, the authors say: "This was well seen in the Oban specimens while living; the more perfect female specimens when suspended in a jar of sea water in the dark, and irritated or excited by gently brushing the leaves, exhibited a fine display of phosphorescence, the different polypes, when touched, showing minute brilliant points of light which appeared to flash over the whole surface of the feather in rapid irregular corruscations." Panceri's observations on this subject are adopted, and his views presented at some length.

HETEROGENETIC DEVELOPMENT IN DIAPTOMUS, ETC., CORRECTIONS.—The editors kindly allow me space to make the following emendations to the article entitled Heterogenetic Development in Diaptomus, rendered necessary by an unfortunate loss of proof in the mail.

Cyclops pectinatus (p. 499) should have stood "*C. thomasi*

Forbes?" It is at least the southern representative of this species, which consequently is distributed from the Great lakes in Minnesota to the gulf. The similarity to *C. bicuspidatus* Cls., is very close.

The description of Epischura (pp. 384–85) was written before the second part of Mr. Forbes' paper was obtained, and in making up for the press, the generic description given in that place was not referred to. It might be inferred from remarks on p. 384, that in *E. lacustris* the female has a structural modification of the abdomen, which is obviously not stated by Forbes.

Although the writer has since succeeded in rearing one Copepod (Canthocamptus), and observing the transition from one of the dimorphic conditions to another, and the two stages, in both of which eggs are carried, are strikingly diverse, it should be admitted that perhaps too much confidence was expressed in the inferred conclusions upon Diaptomus.

It may be that Brady has confused two distinct species in his account of *D. castor*, inasmuch as his descriptions disagree with those of Sars. It is evident that the same peculiarities of distribution maintain in England as here, however explained. Corrections and information bearing upon these questions are earnestly solicited.

An opportunity for comparing types of *Diaptomus pallidus* with *D. sicilis* shows that the differences are even less than indicated, consisting of the greater robustness of the latter and a greater elongation of the antennæ in the former. There is a difference of .1^{mm} in the length of the living adults seen.—*C. L. Herrick.*

The Coxal Glands of Arachnida and Crustacea.—In this journal for September, 1875, we described certain gland-like organs of Limulus, supposed to be renal in their nature, situated at the base of the legs. We then said that the organ "in its general position and relations was probably homologous with the green gland of the Decapod Crustacea, and its homologue in the lower orders of Crustacea, which is supposed also to be renal in its nature. It may also possibly represent the organ of Bojanus in the Mollusca, which is said to be renal in its function. It perhaps represents the glandular portion of the segmented organs in worms."

In the Proceedings of the Royal Society, No. 221, 1882, Professor Lankester, in a paper "On the coxal glands of Scorpio, hitherto undescribed and corresponding to the brick-red glands of Limulus," revoking his first expressed opinion (*Quart. Journ. Mic. Sci.*, 1881) that these were not "of a glandular nature at all," concludes from histological examination that they are glands, and calls them "coxal glands." He was also unable, as were ourselves, to find any openings into the great veins, or "to detect the situation of their opening to the exterior." Lankester then de-

scribes the coxal glands of Scorpio, and also finds that the coxal glands of Mygale are elongated and lobed as in Limulus. He remarks: "Possibly such coxal glands are in all cases the modified and isolated representatives of the complete series of tubular glands (Nephrida) found at the base of each leg in the archaic Arthropod Peripatus." As will be seen in the foregoing note on Peripatus, that animal is provided with a series of paired organs which Moseley and Balfour, with Sedgwick, regarded as Nephridia, homologous with those of Chætopod worms.

It now appears that homologous organs exist in a third type of Arachnida, for not only do the spiders and Pedipalpi possess coxal glands, but also the mites. In his excellent "Observations on the Anatomy of the Oribatidæ," in the February number of the Journal of the Royal Microscopical Society, Mr. A. D. Michael describes a sac which he believes to be glandular, and which he calls the "super-coxal gland." The organ was first recognized in the mites of this family by Nicholet, who supposed it to be connected with what he and others imagined to be the stigma.

When the upper part of the cephalothorax, and the adipose tissue which underlies it, has been removed, "what appears to be the enlarged, blind end of a fine colorless sac, may be seen on each side of the body, the seemingly blind end being nearest to the eye; the sac descending obliquely downward and slightly forward, and being attached close to the acetabulum of the coxa of the second leg; a closer examination shows that this is not the only attachment, but that the lower end is apparently bifurcated, and that the second branch is attached much nearer to the center of the body, and higher in level than the coxal branch. On dissecting out this sac, and carefully extending it, a matter by no means easy, it will be found that what seemed to be the blind end was not the end at all, but that the whole organ is an elongated sausage-shaped sac, bent upon itself in the middle and taking a single turn, so that the two halves cross, but for some distance the two limbs of the horseshoe (if I may call them so) lie over each other, or are so closely pressed against one another as to appear one; it is only toward the end, that they stand free from each other when *in situ*."

Mr. Michael suggests that these glands are analogous to the nephridia (segmental organs) of Vermes, and the green gland of Astacus and other Crustacea, and the coxal glands in scorpions and Limulus. The resemblance to the segmental organs of worms, especially the leech, is very considerable as regards the general form of the organ, and to a lesser extent in the minuter structure, and if the double lines described in Michael's account be tubules, "they would be analogous to those in the nephridia. The sac (super-coxal gland) would correspond with the gland in the nephridium, and the globular body with the vesicle."

It thus appears that there is a probable homology between the coxal glands of Arachnida (including mites, pedipalps and spiders) and the Merostomata (Limulus), *i. e.*, the archaic Crustacea; it remains to be proved whether the green glands of the Decapoda, and corresponding organs in other Neocaridous Crustacea are the homologues of the coxal glands described. Meanwhile true segmental organs, seventeen pairs, corresponding to the segments of the body and situated opposite to the bases of the feet, and with external openings situated on the ventral surface of a certain number of the legs, occur in Peripatus. The occurrence of these organs in Arachnida, as well as in Crustacea, indicate the independent origin of these two types of Arthropoda from the forms resembling some of the lower worms. We are next to look for their occurrence in the Myriopods. Possibly the repugnatorial pores of Chilognath may be found to be these glands, which open above the insertions of the legs.—*A. S. Packard, Jr.*

Submetamorphoses of Fishes. — Professor A. Agassiz has published the third part of his researches upon the submetamorphoses of the young of bony fishes, including the genera Labrax, Stromateus, Atherinichthys, Batrachus, Lophius, Cottus, Ctenolabrus, Gadus, Osmerus and some others.

The caudal fin passes through a heterocercal stage before attaining the more or less homoocercal form that characterizes the teleost caudal, and the pectorals pass through phases which recall those of the Crossopterygia.

When two dorsals are formed from the continuous membranous fold which is the source of all the vertical fins, the posterior appears to be usually differentiated before the anterior, but first passes through a phase in which the two are confluent, though the anal and caudal are already distinct. In Lophius the abnormal form of the first dorsal is evident in embryonic stages, and this is also the case in other forms with filamentary rays in front of the dorsal. The anal is developed before the ventrals except when the latter are adapted to some special purpose, as in the young of some ganoids,, in some deep-sea fishes and in forms in which the ventral rays form long tactile filaments. The young of *Lophius piscatorius*, when about an inch and a quarter long, looks almost like a butterfly from the great development of its paired fins, and the same occurs in the genus Onus. These extraordinary ventrals represent the enormous appendages of Pterichthys and other Devonian genera.

In the position of the mouth, the cartilaginous skeleton, the heterocercal tail, the great pectorals, and the rudimentary dorsal and anal fins, the young of existing osseous fishes recall the primitive fishes, the transformations of which into modern types can be traced through the geological ages from the Devonian upwards.

Many fishes leave their eggs floating upon the surface of the sea as, for example, the cod, some flat fishes, Ctenolabrus, Cottus, etc. Eggs thus obtained are in excellent state for embryological purposes, and from the advanced state of their segmentation it is probable that they are deposited at night, which, as Mr. Ryder first observed, is the time chosen by many marine fishes. The eggs of Lophius float on the surface in the form of great ribbons, agglutinated by a mucous material.

THE OSTEOLOGICAL CHARACTERS OF THE GENUS HISTRIOPHOCA.—About two years ago two specimens of the ribbon seal (*H. fasciata*), a male and a female, were obtained by Mr. Wm. H. Dall at Plover bay, East Siberia, and deposited in the National Museum. In the skeleton of the female the preparation of which is now completed, we have, so far as I am aware, the first accessible material for an accurate diagnosis of the genus.

Diagnosis of the genus Histriophoca.—General appearance of the skull short, broad and rather high. Dental formula as in Phoca and Halichœrus. Molars small, conical, with rudimentary accessory cusps; single rooted, except the last three upper and last lower ones. Facial portion of the skull very short and of medium breadth. Nasal bones small and very short. Palatal area broad, elliptical, moderately emarginate behind. Narial septum nearly complete. Interorbital bridge narrow; orbital fossæ short but broad. Supraorbital processes rudimentary. Brain case large, occupying one-half the length of the skull. Auditory bullæ very large. Lower jaw of medium length, small; rami as in Phoca. Scapula without acromion. Iliac crests abruptly everted. First digit of the manus longest.

From the foregoing diagnosis it is apparent that the genus bears close relations to the other genera of the sub-family. It is difficult to decide to which it most closely approximates, but I should be inclined to place it between Phoca and Erignathus. It is my intention to publish elsewhere,[1] in a short time, a thorough description of the skeleton, upon a consideration of the characters of which this view is based.—*Frederick W. True, March 12, 1883.*

THE BREEDING PLACE OF THE LITTLE AUK.—The accompanying view of Foul bay, on the west coast of Greenland, with glaciers descending into the sea, is taken from Nordenskiöld's voyage of the *Vega;* while it is a characteristic Spitzbergen view, and probably fairly well represents the aspect of the coast of Maine during the height of the glacial period, it was designed by the author to illustrate the breeding place of the little auk (*Mergulus alle* Linn.). This is one of the most abundant of the sea birds of Northern America and Europe, straying south in the winter along our coast as far as the Middle States, and being sometimes driven inland by storms.

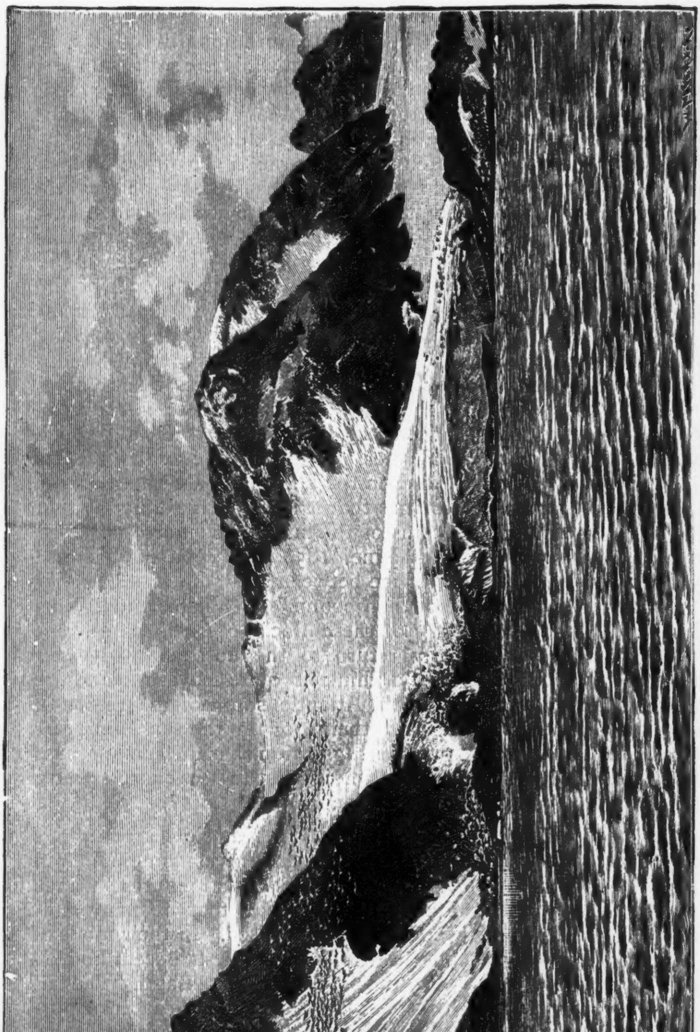
On Spitzbergen it occurs in incredible numbers, and breeds in the talus, 100 to 200 meters high, which frost and weathering form on the steep slopes of the coast mountain sides. These stone heaps form the palace of the rotge (or sea king, as the little

[1] In the Proceedings of the U. S. National Museum.

auk is variously called), richer in rooms and halls than any other in the wide round world. "If one climbs up among the stones, he sees at intervals actual clouds of fowl suddenly emerge from the ground either to swarm round in the air or else to fly out to sea, and at the same time those that remain make their presence underground known by an increasing cackling and din, resembling, according to Friedrich Martens, the noise of a crowd of quarreling women. Should this sound be stilled for a few moments, one need only attempt, in some opening among the stones, to imitate their cry (according to Martens: *rott-tet-tet-tet-tet*) to get immediately eager and sustained replies from all sides. The fowl circling in the air soon settle again on the stones of the mountain slopes, where, squabbling and fighting, they pack themselves so close together that from fifteen to thirty of them may be killed by a single shot. A portion of the flock now flies up again, others seek their safety, like rats, in concealment among the blocks of stone. But they soon creep out again in order, as if by agreement, to fly out to sea and search for their food, which consists of Crustacea and Vermes. The rotge dives with ease. Its single bluish-white egg is laid on the bare ground without a nest, so deep down among the stones that it is only with difficulty that it can be got at. In the talus of the mountains north of Horn sound, I found on the 18th June, 1858, two eggs of this bird lying directly on the layer of ice between the stones. Probably the hatching season had not then begun." "Where," adds Nordenskiöld, "the main body of these flocks of birds passes the winter is unknown, but they return to the north early—sometimes too early." We should think it quite obvious that the birds scattered over the North Atlantic south of the region of winter ice, where they can find their food in the sea; but Nordenskiöld adds in a footnote the suggestion that they may "pass the winter in their stone mounds, flying out to sea only at pretty long intervals in order to collect their food."

Zoological Notes.—*Vermes.*—Mr. J. S. Kingsley (Proceedings Boston Society Natural History 1882, 441) gives some points in the development of *Molgula manhattensis*, and figures various stages. The segmentation closely resembles that of many mollusks. The blastopore becomes entirely closed. In their mode of origin and position the cells destined to form the tail seem homologous with those which form the tail-fold of vertebrates. The tail continues to grow until it reaches entirely round the anterior portion of the embryo, and about the same time the eye-spot forms. The chorda dorsalis commences to break down previous to hatching. The general appearance and mode of swimming of the young resembles that of the batrachian tadpole. Certain processes develop upon the surface of the body, but are finally absorbed without serving, as has been believed, as aids in the attachment of the larva.

PLATE XX.



Foul bay, on the west coast of Greenland, with glaciers. From Nordenskiöld.

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Mollusks.—The deep-sea mollusks are still engaging the attention of malacologists. From Mr. Gwyn Jeffreys we have received a recent paper on the mollusks of the "Lightning" and "Porcupine" expeditions, in which he gives the results of comparison of these shells with subappennine and Sicilian tertiary shells; teaching first, the exact concordance of so many species in their fossil and recent state, notwithstanding the lapse of the enormous and incalculable time which has intervened, and second, the extensive changes which have taken place during the same period between the depth of the ocean and the height of land in the North Atlantic area. In the Linnæan Society's journal appears parts XV and XVI of Rev. R. B. Watson's Mollusca of the *Challenger* expedition.

Crustaceans.—M. Hartog has been studying the unpaired median eye which he regards as the primitive eye of the Crustacea, since it exists in the naupliiform larvæ of all the orders, and even in the phyllosomatous larvæ of the loricate decapods. It is the only eye the Copepoda possess, but the single eye of the Cladocera is formed by the union of the two compound eyes. This eye, as shown by Claus, consists of a central pigmented mass in which are immersed two lateral and a central lenticular crystalline spheres. The eye is situated on the terminal process of the brain, and the optic nerves proceeding from it skirt the outer surface of the crystalline sphere and penetrate it near the hinder margin. This eye, therefore, may be considered as composed of three simple eyes, placed anterior to the brain, with reversed optical bacilli, and brought so close together that their pigmented or choroid layers are combined into a single mass. The eyes of the Chætognaths, though paired, have a similar structure, and certain Planarians have eyes like one of the simple eyes that are united in the median eye of the Crustacea.

Vertebrates.—The fecundation of the ova of the lamprey is accomplished by actual copulation, but the ova are many and small, and are deposited in the same manner as in the majority of fishes. In sharks, rays, viviparous perch, and other fishes in which sexual union takes place, the eggs are few and large, and fecundated egg develops within the body of the mother. The European lamprey, according to M. L. Ferry, has by the end of June or beginning of July deposited its ova and regained the sea, which it left early in the spring.——G. Smirski has published a paper on the development of the shoulder girdle and the skeleton of the pectoral fin of the pike. Gegenbaur's Morphologisches Yahrbuch, in which the essay is noticed, also contains a paper on the development of the vertebræ of teleosts, by B. Grassi; also G. Baur's article on the tarsus of birds and Dinosaurs; it also notices Aeby's paper on the bronchial tube of mammals and man.——Dr. Yarrow's check list of North American Reptilia and Batrachia, issued by

the United States National Museum, forms a volume of 250 pages; the nomenclature and classification being based on the list of Professor Cope, forming the first bulletin of the series, of which the present is the twenty-fourth.——Recent experiments by Drs. Mitchell and Reichert, indicate that *Heloderma suspectum* is poisonous. It is usually sluggish in its habits, and will not bite unless provoked; but when the full-sized lizard (it grows to a length of three feet) does bite, it produces a poisonous wound, which may prove fatal. For the purpose of experiment, Dr. M. caused the lizard to bite on the edge of a saucer, and when saliva commenced to flow it was caught on a watch glass. Differing from the saliva of venomous reptiles, which is always acid, the saliva of the Heloderma is alkaline. A very small quantity injected into a pigeon produced its effect in a tottering gait in less than three minutes, and caused death in less than nine minutes. The specimen presented was fourteen inches long, fat and plump. See NATURALIST, 1882, p. 907.——That pigs will dive for fish is averred by J. C. Hughes, in *Forest and Stream*, who, writing from British Columbia, says: "Pigs living upon the clear-water rivers learn to dive after the salmon lying dead on the bottom of the streams, and the interesting sight may be witnessed of a sow diving for a salmon, and when obtained taking it ashore for her little ones."

General.—The third heft of the current volume of Gegenbaur's Morphologisches Yahrbuch contains a paper by Bütschli on a hypothesis relative to the derivation of the vascular apparatus of a part of the Metazoa.——Under the title, "Life, and its physical basis," Professor H. A. Nicholson discusses protoplasm, and so-called "vital" phenomena; while he discards the old "vital force" of the vitalists, he holds the hypothesis of an inner directing power in the vital phenomena of the higher to be absolutely inevitable, and that if this applies to man so it must to the moner.

PSYCHOLOGY.

GLUTTONY IN A FROG—A rather interesting incident occurred while I was a student in the Sheffield Scientific School, of Yale College. In the Peabody Museum we had a large wire cage containing numerous reptiles, and among these was a frog of unusual size.

On one of our excursions I brought in a number of frogs and other animals, and going to the cage dropped the contents of the jar, frogs and all, down among the animals at the bottom. The large frog, which had been confined there for some time, caught one of the small ones before it reached the bottom of the cage, and swallowed it with as great ease as he would have captured a fly. This quickly done, he sat and looked about with an air of satisfaction for a moment, then sprang upon another of medium size, caught and swallowed it as quickly as the first. This done,

there was another pause of a couple of minutes, and then with another quick bound, he seized and swallowed a third frog, equal in size to the second; this accomplished there was another pause of about five minutes, and then another quick, savage bound for a fourth victim, this time for a frog two-thirds the size of himself. Each of the three was seized and swallowed head first, but the fourth effort was not so successful as the others, for this he only managed to get into his mouth as far as its hind legs, when there was a pause and a struggle. The unfortunate frog in the mouth of the large one persisted in holding its hind legs out sidewise, at right angles to its body, as if conscious that these tactics would prevent the other from swallowing it; and at the same time the large one used its front feet, at times one, and again both, to straighten out the hind legs of his victim so that he might be able to swallow it; and while this struggle was going on, he made frequent efforts to use the sides and bottom of the cage as an object against which to press the other frog, so as to aid his efforts to swallow it. The struggle, however, after lasting a number of minutes terminated in favor of the smaller frog, for by desperate efforts it managed to elude the grasp of its assailant; but while the battle did last it used both its muscular and vocal powers to their utmost to thwart the murderous designs of its enemy.—*B. F. Koons, Mansfield. Conn., May 22d, 1883.*

Activity of the Senses in New-born Infants.—In a recent inaugural dissertation, Dr. Genzmer discusses the activity of the senses in new-born infants. *Inter alia*, he says the sense of touch is developed from the earliest period, and reflex actions are readily excited by the slightest stimulation of the nerves of touch, especially of the face, then of the hands, and soles of the feet. The feeling of pain is but slowly developed, and is only clearly shown after four or five weeks, before which time infants do not shed tears. Smell and taste are not distinguishable in infants. Hearing is perceptible in the first, or at most, the second day of life. New-born infants are so sensitive to light that they will turn the head to follow a mild light; while, if a strong glare be suddenly thrown on the eye, squinting is induced, and even convulsive closure of the lids. After a few days the child will follow the motion of various objects by movement of its head. Between the fourth and fifth weeks the convergence of the pupils and coordination in vision are perceptible. A distinct perception of color does not exist under four or five months; before then it is quantity rather than quality of light that is recognized.—*English Mechanic.*

ANTHROPOLOGY.[1]

The growth of Children.—Dr. George W. Peckham, professor of biology, Milwaukie, Wis., has been making inquiries concerning the growth of children in that city. Cards similar to

[1] Edited by Professor Otis T. Mason, 1305 Q street, N. W., Washington, D. C.

those used by the Massachusetts Board of Health were distributed to all the teachers, who heartily coöperated in the work. The queries included sex, age, weight, height (upright and sitting), color of eyes, hair, and skin, nationality and occupation of parentage. Writers on anthropometry have commonly studied the influence of age, sex, race, occupation, and general surroundings, without sufficient regard to the physiological laws through which they act. The size of an organism and more definitely of any group of organisms is limited, and the influence which determines the amount of food that can be assimilated under the conditions supposed is a power transmitted from parent to offspring, and known as the law of heredity. The size of an organism is the result of its inherited tendency as modified by the two varying factors of waste and repair. By far the greater portion of an individual's surroundings are determined for him by the degree of density of population in the locality in which he lives. Some excellent remarks are made on Plato's idea of archetypal forms, and the comparative value of means and averages, with a decided preference for the latter. In this the author has probably sacrificed ease to accuracy, except in very homogeneous groups. The tables in the pamphlet, showing the comparative growth of the sexes from five to twenty years, are very interesting indeed, and the addition of nationality and other factors bring out results worthy of consideration.

The reflections upon climate are quite startling. Indeed, it is deemed improbable that climate has any considerable modifying effect upon growth. This statement is subjected to a searching examination in the light of researches, such as those of Gould, Baxter, Walker and Beddoe. Walker's Atlas and Baxter's Report, studied together, give abundant proof of the non-dependence of stature on climate.

The density of population acts in two ways upon growth: It modifies, first, the hygienic conditions of the whole population, controlling the influence of occupation; second, the intensity and character of the struggle for existence.

It would seem that the superiority of stature in males over females is due to two factors: first, the arrest of growth of lower extremities in girls at about fourteen and a half years, boys experiencing no retardation in their rate of growth; second, to the falling off of the rate of growth in the bodies of girls at about the fifteenth year, and the termination of their growth at about the seventeenth year.

The American Antiquarian.—The second number of the current year contains the following papers:

The Hill Tribes of India. By Professor John Avery.
Indian migration as evidenced by language, II. By Horatio Hale.
Native races of Colombia, S. A., IV. By E. G. Barney.
The Somme implements and some others. By S. F. Walker.

The Potlatches of Puget Sound. By M. Eells.
Mythology of the Dakotas. By S. R. Riggs.
Village habitations. By S. D. Peet.
Specimens of the Chumeto language. By A. S. Gatschet.
Relics in Maine. By Charles B. Wilson.

The linguistic notes of the *Antiquarian*, by Mr. A. S. Gatschet, are of great value.

THE PIPE OF PEACE.—Mr. E. A. Barber has an illustrated article on the pipes of the American aborigines in *The Continent* for April 4th, which brings together much information of value. It is pleasant to read the descriptions of the old writers of the conquest. Says one: "The salvages possessed a kinde of herbe dryed, which, with a cane and an earthen cup in the end, with fire and the dryed herbs put together, do sucke through the cane the smoke thereof, which smoke satisfieth their hunger, and therewith they live foure or five dayes withoute meate or drinke." Another says: "This cornet of claie is a little pan, hollowed at the one side, and within whose hole there is a long quill or pipe, out of which they suck up the smoak, which is within the said pan, after they put fire to it with a coal that they lay upon it."

COMPARATIVE AND PHILOSOPHICAL RESEARCHES INTO THE CHARACTERS OF THE CRANIUM AND BRAIN.—The Bulletin of the Zoölogical Society of France for 1882 contains a treatise upon this subject by Dr. L. Manouvrier, a pupil and disciple of Broca. For fullness of detail and breadth of view, this work, which occupies 116 pages, stands far in advance of the majority of treatises upon the comparative characters of the brain. The author advocates a uniform system of craniometry, to the end that the observations taken by various craniologists may be compared with each other, and he combats the idea, held by many anthropologists, that seemingly unimportant characters, which can be described with precision, are not worthy of notice. The author differs from those who regard it as proved that the brain of the female is inferior to that of the male. The female cranium approaches in type that of a youth of the male sex, but the cranium is in relation exteriorly to the muscular system, while the brain, which influences its internal characters, is itself in relation with the motor and vegetative functions as well as with the purely intellectual ones. The relations of the brain with the intellect cannot therefore be understood unless those it has with other parts of the organism are first separated. In order to appreciate the influence of the intellectual and of the physical development on the form and quantitative development of the brain and cranium, it becomes necessary to compare individuals and groups of individuals presenting very evident difference in the development of intelligence or that of the body, such as 1st, different species of vertebrates that are nearly equal in intelligence but of different size, or vice versa; 2, individuals of the same species, but of different ages; 3, indi-

viduals of diverse races; 4, the two sexes. The conclusions Dr. Manouvrier, working be it remembered on the lines laid down by Broca, has arrived at from the last comparison, are best stated in his own words. "The strongest women, especially in the civilized races, have scarcely more muscular force than the feeblest men. The intellectual functions, on the contrary, present no appreciable difference. It is true they are applied to different objects and in consequence offer diverse sexual peculiarities, but nothing authorizes us to say that these functions are superior in intensity in either sex. * * * * * It is true that certain writers have succeeded in making some noise these last few years by reëditing, apropos of the sexual difference of cranial capacity and weight of brain, the antique pleasantries relative to the lightness and inconstancy of women. Unfortunately for these writers, the lightness with which they have themselves passed over anatomical differences as enormous as that in muscular development of which I have just spoken, permits serious doubts as to their aptitude for psychological analysis."

The author devotes a chapter to the comparative quantitative development of the brain and of various parts of the skeleton. The femur and the mandible, according to our author, represent, by their weight, the development of those parts of the organism which influence the brain-weight, far better than do the size and weight of the body. He therefore takes, and recommends others to take, these two bones, with the addition, when possible, of the humerus, for the purpose of comparison. Unfortunately most skeletons are so mounted that the two bones first mentioned with the skull are the only pieces that can be separated.

To us it appears that the femur is about the worst bone that could be chosen for the purpose of instituting a comparison between the brain and the skeletal development of the two sexes, since its very considerably smaller size in the female gives that sex an altogether fictitious advantage.

In weight of cranium the negro races surpass any others that have been subjected to comparison, so that the proverbial thickness of a negro's skull has a foundation in fact. The skulls of Papuans and natives of New Caledonia are heavier than those of Parisians, while those of the American aborigines and of the Bengalese are lighter.

The weight of the female cranium, absolutely about one-seventh less than that of the male, is, according to the limited observations yet made, about two-ninths heavier when compared with the rest of the skeleton, showing an approach to the type of youth. In a child of six months the weight of the skull is nearly equal to that of the rest of the skeleton. The importance of the skull as a skeletal element diminishes in the following order: 1. Infant. 2. Woman. 3. Man of low stature. 4. Man of high stature. 5. Anthropoid apes. The weight of the brain in proportion to that of the body follows the same order as that of the

cranium, and is thus proportionally heavier in woman than in man, and, if allowance be made for the greater development of adipose tissue in the former, the advantage of woman in brain-weight would be still more marked. Although, on the whole, there is a parallelism between the weight of the cranium and its capacity, this relation is not absolute, and a comparison between a series of masculine and one of feminine skulls proves that the latter have greater capacity in proportion to the weight than the former. The results of an extensive series of measurements prove that the cranial capacity is greater in proportion to the weight of the skull in Parisians, Europeans generally, and Hindoos, than in negroes or other inferior races, and that in a new-born infant both cranial capacity and weight of brain, as compared with weight of skull, are three times that of the adult.

The weight of the mandible, compared with that of the skull, is greater in man than in woman, so that in this character civilized man occupies a position between civilized woman and the inferior races, but if the weight of the mandible in woman be compared with that of the femur, it is greater in woman.

The impression conveyed by a careful reading of the memoir is that the connection between brain development and intelligence is so complicated by the relations between the brain and the motor, nutritive, and, it may be added, reproductive functions, and also by those between it and the size and age of the individual, that it is impossible, with our present knowledge, to judge with any certainty of the intelligence of an individual by the weight of the brain, the capacity of the cranium or any relation of these to the entire skeleton or portions of it. Yet some of the relations established seem to point the road to further knowledge of this most abstruse of subjects.

In Memoriam.—The third part of volume III, proceedings of the Davenport Academy, is devoted to the life and labors of the late J. Duncan Putnam. The engraving in front is as near perfection as a portrait can come, and will recall that pale, earnest, honest face that so many loved to look upon. The volume throughout is worthy of the subject, and of the generous spirits who assembled to pay their sincere tributes to modest worth. The closing portion of the pamphlet is devoted to a monograph of the Solpugidæ, to which Mr. Putnam had devoted much time. It is his work as patron, editor, and enthusiastic friend of the Davenport Academy, which will give him an enduring place in the hearts of anthropologists.

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If the object is imbedded in celloidin, as is now frequently done, the sections may be smoothed out with benzine or chloroform, which softens the gutta-percha and thus fixes them in position. After the sections have dried on, they may be stained, washed and transferred to absolute alcohol as before. The application of clove oil before the balsam dissolves the celloidin.

THE HERTWIGS' MACERATING FLUID.[1]—For the isolation of tissues in the Cœlenterates, Oscar and Richard Hertwig recommend the following mixture:

Acetic acid	1	part.
Osmic acid	$\frac{1}{5}$	"
Sea water	1000	"

By means of this fluid not only the nerve cells, muscle cells, etc., can be isolated so that the exact form of the individual cells may be easily recognized, but also the tissues in the form of thin lamellæ may be separated and studied as a whole. Pieces of tissue or whole animals are left in the mixture five to ten minutes, and then washed for several hours in one-fifth per cent acetic acid. The macerated parts can be further prepared and afterwards colored on the slide; or they can be colored at once before preparation with needles. In the first case picrocarmine is used,

[1] Jenaische Zeitschrift, XIII, p. 462, 1879.

in the second, Beale's carmine, because it does not harden the tissues, but assists rather the process of maceration. Pieces of tissue may be preserved a long time in glycerine diluted with an equal volume of water, provided a few drops of carbolic acid have been added to secure against mold and Bacteria.

To obtain preparations of single-cell elements of Actiniæ, the macerated portion must be carefully divided up into smaller parts by needles, and one or more of these parts placed under the cover-glass. Light blows on the cover-glass with a needle will cause the cells to separate. Care should be taken to support one side of the cover by a hair, which is removed quite gradually, after the object has been reduced to very small cell masses. Sliding of the cover may be avoided by placing wax feet under its corners.

Dr. Mark has employed this method and obtained excellent results with it. As he remarks, the great merit of this fluid is, that it separates the cell elements and hardens them at the same time. The *dissociative* and the *preservative* agent are combined in such proportions that the action of the former is confined within desired limits by that of the latter.

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SCIENTIFIC NEWS.

—Dr. Loring, commissioner of agriculture, has forwarded to the secretary of the treasury the following statement submitted to him by Professor Riley, the entomologist of the department, who says: In reply to the letter of the assistant secretary of the treasury, with inclosures from the New York custom house respecting an invoice of vine cuttings from Madeira, suspected of Phylloxera disease, I would state: The samples submitted, upon examination, furnish no sign whatever of Phylloxera, and it is extremely doubtful whether any trace of Phylloxera could be discovered upon any of the cuttings now held in New York—first, because Phylloxera is not known to be destructive in Madeira, and second, because it could only be found in the winter egg, which even in countries where Phylloxera abound, is extremely rare. Hence the chances of the introduction of the pest upon these cuttings are so very remote as not to be worth considering; but even if the cuttings came from a country badly infested with Phylloxera the danger of the introduction of the pest upon them would be very slight, the reason for which conclusion Professor Riley has already discussed in the AMERICAN NATURALIST for March, 1881. Even were it possible to introduce the insect, no harm could result so long as the cuttings were sent to any part of the United States east of the Rocky mountains, since the Phylloxera is indigenous here. On the same supposition that the cuttings are badly infested, prudence would dictate that they should not be sent to the Pacific States, or those portions of it

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Osmic acid	$\frac{1}{5}$ "
Sea water	1000 "

By means of this fluid not only the nerve cells, muscle cells, etc., can be isolated so that the exact form of the individual cells may be easily recognized, but also the tissues in the form of thin lamellæ may be separated and studied as a whole. Pieces of tissue or whole animals are left in the mixture five to ten minutes, and then washed for several hours in one-fifth per cent acetic acid. The macerated parts can be further prepared and afterwards colored on the slide; or they can be colored at once before preparation with needles. In the first case picrocarmine is used,

[1] Jenaische Zeitschrift, XIII, p. 462, 1879.

in the second, Beale's carmine, because it does not harden the tissues, but assists rather the process of maceration. Pieces of tissue may be preserved a long time in glycerine diluted with an equal volume of water, provided a few drops of carbolic acid have been added to secure against mold and Bacteria.

To obtain preparations of single-cell elements of Actiniæ, the macerated portion must be carefully divided up into smaller parts by needles, and one or more of these parts placed under the cover-glass. Light blows on the cover-glass with a needle will cause the cells to separate. Care should be taken to support one side of the cover by a hair, which is removed quite gradually, after the object has been reduced to very small cell masses. Sliding of the cover may be avoided by placing wax feet under its corners.

Dr. Mark has employed this method and obtained excellent results with it. As he remarks, the great merit of this fluid is, that it separates the cell elements and hardens them at the same time. The *dissociative* and the *preservative* agent are combined in such proportions that the action of the former is confined within desired limits by that of the latter.

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SCIENTIFIC NEWS.

—Dr. Loring, commissioner of agriculture, has forwarded to the secretary of the treasury the following statement submitted to him by Professor Riley, the entomologist of the department, who says: In reply to the letter of the assistant secretary of the treasury, with inclosures from the New York custom house respecting an invoice of vine cuttings from Madeira, suspected of Phylloxera disease, I would state: The samples submitted, upon examination, furnish no sign whatever of Phylloxera, and it is extremely doubtful whether any trace of Phylloxera could be discovered upon any of the cuttings now held in New York—first, because Phylloxera is not known to be destructive in Madeira, and second, because it could only be found in the winter egg, which even in countries where Phylloxera abound, is extremely rare. Hence the chances of the introduction of the pest upon these cuttings are so very remote as not to be worth considering; but even if the cuttings came from a country badly infested with Phylloxera the danger of the introduction of the pest upon them would be very slight, the reason for which conclusion Professor Riley has already discussed in the AMERICAN NATURALIST for March, 1881. Even were it possible to introduce the insect, no harm could result so long as the cuttings were sent to any part of the United States east of the Rocky mountains, since the Phylloxera is indigenous here. On the same supposition that the cuttings are badly infested, prudence would dictate that they should not be sent to the Pacific States, or those portions of it

where the Phylloxera does not exist; but for the reasons first given, I do not hesitate to say that there can be no danger in sending them even there, so that they may certainly be forwarded without fear of injury.

— The St. Paul Academy of Natural Sciences lost its valuable collection by the burning of the capitol two years ago. Without means to repair the great loss, its work was interrupted and for a while suspended. The society is now ready to resume active work. It has rented convenient and accessible rooms on the ground floor near the State house, at the south-east corner of Wabasha street and College avenue. It has elected as curator and corresponding secretary, Professor Edward Daniels. Help is now wanted for the following purposes:

First. To make a complete collection of all ores, building stones, clays, marls, cements, coal peat and other useful material in economic geology, for the use of students, mining engineers, builders and practical men generally.

Second. To collect the remarkable and interesting fossils from the great region west of and tributary to St. Paul, and all living species.

Third. To found a complete scientific library.

Fourth. To establish courses of popular lectures, and classes for practical instruction in the physical sciences.

To effect this purpose is asked:

First. Donations in money.

Second. Scientific books, pamphlets, and illustrative apparatus to replace what was lost by the fire.

Third. Specimens of ores, minerals, fossils, plants, bones and skins of animals that can be mounted, insects, birds (especially of the Northwest), shells, reptiles, and all objects of natural history. All money to be paid to the treasurer, D. L. Kingsbury, Esq., of the firm of Bennett & Kingsbury.

Specimens should be sent to the curator, Professor E. Daniels, at the academy room, 554 Wasbasha Street, St. Paul, Minn.

— The eleventh annual report of the directors of the Zoölogical Society of Philadelphia, Mr. Arthur E. Brown, superintendent, shows that the number of annual members is 577, the total number of members being 783. There was an increase the past year of 9439 in the number of visitors. While no permanent improvements have been recorded, over 2000 trees and shrubs have been planted in the garden. One of the most interesting additions recorded was a large Siren (*Siren lacertina*) from South Carolina. Although this curious batrachian endures captivity well, it seemed impossible to exhibit it in a satisfactory manner. The necessities of its life requires it to be buried in several inches of soft mud, which obscures the water as soon as it begins to move, so that it is generally hidden from view. A very rare fox (*Vulpes littoralis*) from Yucatan has been added; this specimen is probably the first

to be exhibited in a living state. Among other additions were two chimpanzees, a male ostrich, an Egyptian ichneumon, three rare monkeys from South America, a two-toed sloth, thought to be *Cholœpus hoffmanni*, also lemurs and several rare birds. It appears that six dingos (*Canis dingo*) were born in the garden, and one black wallaby, as well as a zebu.

— The fourteenth annual report of the trustees of the American Museum of Natural History, states that a contract has been made with Professor Ward for a collection of all the monkeys of the world. Extensive collections illustrating the ethnology of British Columbia have been likewise added. A rather new and valuable feature has been added, that of public lectures by the superintendent, Professor Bickmore, over 150 teachers attending the course. The trustees appeal to all public-spirited citizens for an endowment to place the museum upon a footing "commensurate with the prospective greatness of our nation;" while it also asks for provision by the city for the erection of another wing to contain the rapidly-increasing collections.

— The Newport Natural History Society was organized in May, at Newport, R. I., with the following officers: President, Professor Raphael Pumpelly; vice-presidents, Hon. Samuel Powel, ex-Governor C. C. Van Zandt, Hon. Francis Brinley, Professor Fairman Rogers, Mr. James Gordon Bennett, Mr. James R. Keene, Dr. Horatio R. Storer, Gen. Robert B. Potter, Colonel Geo. E. Waring, Colonel George H. Elliot, U. S. Engineer Corps, and Dr. Samuel W. Francis; secretary, Captain John A. Judson, C. E.; corresponding secretary, Mr. Geo. C. Mason; treasurer, Dr. William C. Rives, Jr.; librarian, Lieut. William McCarty Little, U. S. Navy; curator and microscopist, Dr. J. J. Mason.

— At the annual meeting of the Worcester Lyceum and Natural History Association much interest was exhibited in museum and natural history work. Mr. F. G. Sanborn is the curator of the museum. The society is outgrowing its present quarters and requires larger rooms. To meet the demand for the study of living plants and animals an outdoor enclosure is absolutely needed. There is manifested an increasing desire for knowledge on the part of visitors and a steady growth of interest in the study of zoölogy, botany and geology. Accompanying the report is a long list of gifts to the society.

— The eleventh annual report of the curator (Professor W. N. Rice) of the Museum of Wesleyan University, indicates much activity in this growing collection. The most important accessions appear to be the skins of fourteen Australian marsupials, besides the Ornithorhyncus and Echidna, as well as the great lizard Hadrosaurus. The museum is now in good order, and excellent from an educational point of view.

— The death is announced by telegram from Madeira of Mr. William Alexander Forbes, B.A., prosector to the Zoölogical

Society of London. Mr. Forbes was engaged in an expedition up the River Niger, but succumbed to dysentery at the early age of 28. He was the successor in office of the late Mr. Garrod, and the author of valuable papers on the anatomy of birds. He made a visit to the naturalists in this country a short time since. His loss, like that of Jevons and Balfour, is a serious one for England.

— Professor Gabriel Gustav Valentin, the noted German physiologist, is dead at Berne. He was the author, among other notable works of essays on the hibernation of animals, of several embryological papers, a work on physiology, and a handbook of the developmental history of man.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Biological Society of Washington, May 11.—Communications were read by Professor L. F. Ward, entitled Notes on some hitherto undescribed fossil plants from the Lower Yellowstone, collected by Dr. C. A. White in 1882; by Mr. Frederick W. True, on a new pigmy sperm whale from the New Jersey coast.

May. 25.—Dr. Thomas Taylor, on Actinomykosis, a new infectious disease of man and the lower animals, with exhibition of a portion of the diseased viscera of a dog containing specimens of the fungus Actinomyces; Dr. D. E. Salmon made some remarks on Actinomykosis; Professor C. V. Riley remarked on curious Psyllidæ and certain gall-making species.

New York Academy of Sciences.—May 7.—The following papers were read: On the finding of prehistoric Indian skeletons at Far Rockaway, L. I., by Dr. N. L. Britton; exhibition of some interesting specimens of fossil fishes recently discovered, by Professor John S. Newberry.

May 14.—The "Singing Beach" of Manchester, Mass., by Drs. H. C. Bolton and A. A. Julien; on a form of graphite found at Ticonderoga, N. Y., by Dr. A. A. Julien; exhibition and description of some ores from North Carolina, by Dr. Pierre de P. Ricketts.

May 28.—Notes on the flora and fauna of the islands of Curaçao, Buen Ayre, and Aruba, W. I., by Dr. Alexis A. Julien.

Boston Society of Natural History.—May 16.—Major Hotchkiss read his memoir of the late Professor William B. Rogers.

Appalachian Mountain Club.—May 10.—Rev. William C. Winslow read a paper entitled Camp life in the Adirondacks; Mr. J. Rayner Edmands read a paper entitled The White mountains as seen from Jefferson highlands; and Mr. John Ritchie, Jr., read a paper entitled An ascent of the Jungfrau, illustrated by the lantern.